SUPPLEMENT
TO THE
JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

[REGISTERED AS A NEWSPAPER.]

VOL. XXIX. LONDON, MAY 29, 1877. No. 733.

Parliamentary Intelligence.

HOUSE OF COMMONS COMMITTEE.

TUESDAY, MAY 1.

(*Before Mr.* D. R. PLUNKET, *Chairman: Mr.* FOLJAMBE, *Mr.* STARKEY, *and Mr.* COURTNEY.)

CRYSTAL PALACE DISTRICT GAS BILL.

(*Continued from p.* 816.)

Mr. *Henry Palfrey Stephenson*, examined by Mr. PAULI.

I am a member of the Institution of Civil Engineers, and deputy-chairman of the Crystal Palace District Gas Company. I have been a director of that company since their origin, about 23 years ago. We have come here after mature consideration, and, as we consider, in the interest of the public. Previously to 1873, we were under no obligations to purify from sulphur compounds, the only restriction in our Act of 1858 being with regard to sulphuretted hydrogen. We were specially exempted from the restrictions contained in the Metropolis Gas Act of 1860, after opposition on our part. Excepting for the 17th clause of the Act of 1873, we should have no restriction imposed upon us with regard to sulphur compounds other than sulphuretted hydrogen.

Mr. PAULI: When you heard that limit imposed, you had no idea of the difficulty, or expense, or nuisance that would be involved in carrying out the duty?

Witness: I consulted with another engineer who was in the room, and, looking to the fact that we had made a considerable increase in the area of our purifying power of late years, and not at all anticipating the difficulty which would arise from the waste lime and the foul lime, we were under the impression that we should have no great difficulty in purifying from the sulphur compounds, according to the limit then mentioned. We were anxious to obtain our Bill, and, therefore, we did not raise any objection to the clause, anticipating that we should have no difficulty. Before 1873 we used lime to absorb both carbonic acid and sulphuretted hydrogen. We were not then alive to the necessity of taking the carbonic acid from the gas before the sulphuretted hydrogen. We used a very small quantity of lime in proportion to what we are now using. As soon as we tried to carry out the provisions of that section, we found that our limits as to those sulphur compounds were frequently exceeded, and that it was necessary largely to increase the area of our purifiers, and also the quantity of lime used, and that involved a considerably increased expense. About the year 1867, I think, the area of purifying power was rather over 1000 cubic feet, 16 feet deep; by the year 1873 we had increased it to over 3530 square feet, 6 feet deep; and we have since 1873 increased that by about 50 per cent., or 1750 feet. The sulphur compounds sometimes increased in such a manner that we could not account for them, unless possibly it arose from the waste lime itself giving up some sulphur compounds to the gas instead of taking them from the gas. We now use a process which may be described as two very large lime purifiers, and four oxide purifiers, working the lime purifiers separately—the first one to take out the carbonic acid—and, in the second one, the sulphuretted hydrogen, being driven forwards, forms an artificial sulphide of calcium, which has been found by Mr. Patterson—or was pointed out by Mr. Patterson—to be the material which ought to be used for purifying the gas from sulphur compounds other than sulphuretted hydrogen. After the second purifier the gas passes into the oxide of iron purifiers, of which we have four. We have some lime in the bottom trays of the oxide purifiers, as a sort of safety-valve or guard against any other sulphur compounds passing the sulphide of calcium purifiers. After that long and complicated process, we generally keep the amount under 20 grains, but at first we had considerable difficulty in doing so. With regard to the refuse lime, it becomes very foul and exceedingly offensive. We first used to bury it in the works; but for fear of fouling the stream which is in the neighbourhood, and in consequence of complaints and a memorial from the inhabitants, we found it necessary to give that process up. We then carted it away to an old brickfield, about a mile distant from the works, but after a storm some of the refuse was washed into the river Pool, and so into the Ravensbourne, and it made a great nuisance, causing great complaints. We also had complaints from the inhabitants of the district through which the stuff was carted, and since then we have arranged to send it away by railway trucks, at a cost of about 5*s.* per ton, which entails upon us for that alone from £200 to £250 per year. We send it away in railway trucks especially kept for the purpose, and bought by our company, because the railway company objected to their waggons being used for the foul stuff. We brought a siding up alongside the purifiers, so as to load the trucks direct when we empty the purifiers, so as to avoid causing a nuisance. I have a plan here showing the purifying works, as we had them in 1873, and as we have them now. Before 1873, this being our retort-house [pointing to the plan], the gas was conducted from the retorts along a pipe, called a horizontal condenser, and in travelling along that pipe it travels with the tar and ammoniacal liquor and gas all mixed together. Here it is freed from naphthaline, and tar and ammoniacal liquor, and all the liquid elements, and then it travels along this pipe to what we call the battery condenser, and at this point the liquor there is admitted, and the tar proceeds into the tar-well. Then the gas passes through this battery condenser, which is a huge box with horizontal pipes through it, and it is there cooled down to about 65° at this point. Passing from that it comes into the two scrubbers, which are round vessels made of cast iron, filled with breeze, or with boards, or with broken bricks, about 24 feet high. It is washed in those scrubbers by ammoniacal liquor travelling through the brickbats as the gas proceeds upwards. It is then taken along this pipe to the exhauster, which is for the purpose of pumping the gas through the different apparatus. It then goes into the washer, which is filled with water, and then commences the purification. Before 1873 we had those two smaller lime purifiers of 20 feet by 22 feet; the gas passing through these deposited some of the carbonic acid and sulphuretted hydrogen, we not distinguishing, at that time, whether it was carbonic acid or sulphuretted hydrogen that was taken out of the gas. Then it proceeded to the four oxide purifiers, which took out the sulphuretted hydrogen. In this case, which is since 1873, the purification by the horizontal condenser and the other condensers is the same. We pass now, however, through the washer first, instead of through the scrubber, and then we pass through two scrubbers, in one of which we scrub with ammoniacal liquor, and in the second with very weak ammoniacal liquor; then we pass either to those two purifiers or to this purifier [pointing to the same]. Supposing these two to be used, we use that one to take out the carbonic acid, and that enables the sulphuretted hydrogen to flow into this one, where the sulphide of calcium is formed, which then becomes the purifying agent for the sulphur compounds. When this one is changed, to remove the lime filled with carbonic acid and partly with the sulphuretted hydrogen, then we use these two. As soon as that is changed and refilled with pure lime, then we shut off those two, and proceed to use these two, and those four are, as before, the oxide purifiers, with the exception that we have a bottom tray, or large square boxes with lids upon them, which have a bottom tray filled with lime as a sort of extra safeguard against any sulphur compounds coming over when we are using those two purifiers. There is a difference of area of about 50 per cent. Those two large purifiers are 50 per cent. of the area of these purifiers.

By the COMMITTEE: If we obtain this Bill, we shall use all these oxide purifiers, and, of course, it will save us the erection of some oxide purifiers in the future. If we do not obtain our Bill, I think it exceedingly likely that we shall be compelled to erect large purifiers in place of those two. If we obtain our Bill, we shall only use a very small portion of lime, principally in the trays.

By Mr. CRIPPS: There is nothing exceptional in the form of the purifiers, but there is a little exception in the mode of using them; we work them according to a plan pointed out by Mr. Patterson some few years ago, about which there has been a Chancery suit in two courts.

Mr. CRIPPS: In which you were fortunate enough to succeed.

Examination resumed: The lime, when thoroughly saturated with sulphuretted hydrogen, becomes sulphide of calcium. I have no doubt the effluvium which is smelt arises from the sulphuretted hydrogen, which is very deleterious. I should not like to live in an atmosphere of that kind. We have had, from time to time, a great number of complaints, in particular one in 1875 from 20 inhabitants of the district surrounding the works.

Mr. PAULI read the memorial, which was as follows:—

To the Chairman and Directors of the Crystal Palace District Gas-Works.

Gentlemen,—We, the undersigned inhabitants and householders of Lower Sydenham and Perry Hill, desire to call your attention to the great and increasing nuisance caused by the stench arising from your works, which we believe can at a small expense to your company be considerably mitigated, if not entirely abated. We are given to understand, and believe it to be the fact, that the smell complained of is partially caused by the increased quantity of lime used in purifying, but there is no reason why this should be allowed to become a nuisance; as it should be carted away in closed receptacles, a system adopted by the metropolitan works. The noxious fumes arising from your works have become so intolerable, that they will considerably depreciate the value of house property in the neighbourhood, for several inhabitants of the district have been so often awakened in the night, almost suffocated with them, that unless your engineer adopts measures to prevent a repetition of them, they will be compelled to leave their houses. We appeal to you, as gentlemen connected with a wealthy company, to extend us your sympathy, and to give such instructions to your officers as will afford us relief.

The CHAIRMAN: I gather that that was rather a protest against the practice of storing lime than against the use of it.

Mr. PAULI: It was a protest against the increased use of the lime. They say, certainly, that it would be decreased if it could be carted away in closed vessels.

Examination resumed: However we deal with the lime, we shall always have a considerable amount of offensive smell, particularly at the time of changing the purifiers, or in damp and foggy weather, with the wind in certain directions. Sulphuretted hydrogen is given off the moment the purifiers are opened, and particularly when the foul lime is stirred up. By the time it is put into the vans the smell would have escaped. I understood from Mr. Stevenson's evidence yesterday that at some of the works they take considerable care in sending it away, and yet there is a large amount of smell and nuisance. I do not personally know how the metropolitan companies get rid of their foul lime. Many of them have water carriage, and yet find great difficulty with their lime. I do not think they inquire where it goes to if they get rid of it.

By the COMMITTEE: It is said that it is pitched into the water at the mouth of the river, but I do not know whether that is so or not.

Examination resumed: I have made a very accurate calculation showing the increased cost arising from the extra use of lime which has been imposed upon us. I have taken 3½ years before the passing of our Act of 1873, and 3½ years since the passing of that Act. The cost before the passing of the Act was 0·318 of a penny, and since 0·875 of a penny. But during 1876 we had still further to increase the quantity of lime, and the cost was 1·166 of a penny. The net result to the consumer, taking into consideration the interest, and so on, is a cost of 1d. per 1000 feet, and that would represent about £1500 a year upon the amount sold. During the 3½ years before the passing of the Act, we used 807 cubic yards of lime; but during 1876 we used 1576 cubic yards in that one year, which almost amounts to one bushel per ton of coal carbonized.

By the COMMITTEE: During the whole 3½ years, after the passing of the

Act of 1873, we used 4449 cubic yards. The increase in the quantity of gas did not make an increase in the quantity of lime, but for the purpose of taking out the sulphur compounds we increased the quantity of lime so as to do so more effectually. During the first 3½ years we carbonized 93,720 tons of coal, and during the next 3½ years we carbonized 125,865 tons, but the quantity of gas made does not affect the cost of purification per 1000 feet of gas. During the first 3½ years we used 0·180 bushel of lime per ton of coal carbonized; during the second 3½ years we used 0·742 bushel; but during the last year we used 0·832 bushel, or four times as much as the average of the 3½ years.

Examination resumed: Having regard to the suburban character of our district, it may be assumed that the consumption will increase from year to year, and that therefore more lime will have to be used. We have had nominal penalties imposed on two occasions. We find that if we try to reduce the quantity of lime, then we run the risk of penalties under the Act; but if we increase the quantity of lime, then we run the risk of complaints from the neighbours, and there is a local press, so we get it hot both ways. We have understood that our company have been considered an exemplary one. We have a maximum charge of 6s., but we only charge 3s. 11d. to the general public, and 3s. 7d. to large consumers and the public lamps. In 1873 our illuminating power was raised from 10 to 14 candles, but we did not object to that. In our Act a certain number of hours notice is required previous to testing, but we have waived that with the parish officers. I have never heard of any approximate advantage which has been derived from reducing the sulphur compounds from a little below 30 to, say, 20 grains. I think we should still have to use a considerable quantity of lime with a limit of 30 grains—enough to create a nuisance. I think the great fault among consumers is, that their rooms are not sufficiently ventilated, and very often bad burners are supplied to them, and in consequence a great deal of imperfect combustion takes place.

Cross-examined by Mr. CRIPPS: There was a very strong attempt made to bring us under the Act of 1860, but it was not successful, because we were exempted from the provisions of the measure. When we applied for our Act, in 1873, we asked Parliament for power to raise £150,000 at 7 per cent., but that capital is not yet issued. When it is issued it will only be with a certain amount paid on it, so that we could not take the premiums that the fully paid-up stock of the London companies would take. I should think, if we issue those shares with £2 paid, they will take a premium of from 25s. to 30s., or, perhaps, £2, in the market. The ordinary premium of 7 per cent. stock is about 50 per cent., and that amount will be divided amongst our shareholders as a bonus when it is called up. It must be remembered that when we obtained our original Act we had power to raise £100,000 at 10 per cent., but we only took £50,000 at 10 per cent., and the other £50,000 at 7 per cent., thereby denuding ourselves of £2000 a year.

Mr. CRIPPS: I am not talking about your old Act, but about the Act in which this particular disadvantage, as you term it, was imposed upon you. You did get that £50,000, which, when you want to issue it ultimately among your shareholders, would be worth to them 50 per cent. premium?

The CHAIRMAN: I am not sure I follow the drift of your cross-examination. You do not propose to set off any advantage gained by the shareholders, under this Act of 1873, against the nuisance they would be to the public, do you?

Mr. CRIPPS: I intend to set it off most materially against anything like a complaint of its causing any extra expense in gas-making.

Witness: I do not complain of the cost.

Mr. CRIPPS: It will cost rather more than you have paid at the present time to get rid of that difficulty; but I am now particularly upon the Act which gave you that undoubted benefit on which you first accepted this liability. The population of your district within the metropolitan area is, of course, the part which has been increasing most materially since 1860, and since this prohibition was first introduced?

Witness: I would not say that, because the whole district has been increasing. It is not within my knowledge that the clause complained of was proposed with a number of other clauses by the Metropolitan Board of Works, some of which were put in and some not. My belief is that it came out in the examination or cross-examination of Mr. G. W. Stevenson, and we accepted it under the belief that we could comply with it. The effect of that clause was to impose upon us the same prohibition which had been put upon all the other metropolitan gas companies. The great reason we bring this Bill forward is the nuisance that it commits to our neighbours. The trucks in which the lime is sent away are not closed, but open. The greatest amount of nuisance occurs when the purifiers are opened and the stuff is being thrown into the trucks. On a large scale, there is no way of purifying that lime before it comes out of the purifiers. As a chemical process, if you put a small portion of waste lime into a retort and burn it, I dare say you will throw off all the noxious vapours from it. I very much doubt if it could be done by simply admitting the atmosphere, but I would rather not give an opinion on a chemical point like that. I have heard there were one or two explosions caused by that method being adopted. Whatever of that kind was to be done would, of course, be an increased expense for us.

The CHAIRMAN: With reference to this suggestion of purifying lime by airing it, at what stage of the process is that attempted?

Witness: I have not used it myself.

Cross-examination resumed: When I spoke of being summoned on two occasions, I referred to being summoned, under the Act, for having an excess of sulphur compounds, other than sulphuretted hydrogen in the gas. I do not think we were summoned on the question of nuisance. The Lewisham Board wrote to us complaining very much of the foul water from the brickfield flowing into their stream, but I do not recollect that we were summoned upon that question. The extra penny of expense involved in this matter has not been any detriment of our dividend, because it is paid by the consumer.

Mr. CRIPPS: You mean you would be able to reduce the price to the consumer if you made your gas cheaper?

Witness: I believe so.

Mr. CRIPPS: Do you know whether the consumer is particularly anxious to have this amount of sulphur compounds poured into his room in order to get his gas cheaper?

Witness: I think the consumer is under a misapprehension that he is poisoned by sulphur.

Mr. CRIPPS: Have you had any applications from the consumers to state that they would be willing to take this increased quantity of sulphur as against paying a little less?

Witness: No.

Mr. CRIPPS: You have mentioned the largely increased quantity of lime you had consumed in your works since you undertook this liability, but does not that involve a decrease of the quantity of oxide used?

Witness: I should think not. We sell the spent oxide at a profit, so that we should not object even if we required a little more. We have removed our lime by means of the railway trucks for about seven or eight months, but that was not the plan which was adopted at the time the memorial was addressed to us.

Re-examined by Mr. MICHAEL: The only way in which this expense affects us is that we are, as it were, handicapped as against the surrounding companies. At Croydon they are not under any restriction as to sulphur compounds, and therefore we are obliged to charge 1d. more for our gas than they are, If we were relieved from an obligation of this kind it is the consumers who would be benefited. No process has ever been brought to our notice by which we could discharge the sulphur from the gas without creating a nuisance. If it had, we should have adopted it, unless it was at an enormous expense.

By the COMMITTEE: The large purifier takes one day to empty out, and one day to refill, with 20 men, so that it may be said there are 36 hours during which the stuff is exposed. The actual process takes about 24 hours, but there is the time during which it is waiting in the train to be taken away. During the winter time we change our lime purifiers once in every 12 days. If the purifiers are changed on a day when the wind is blowing directly away from the houses, there would be no complaint on such a day as that; but, in the depth of winter, with the wind blowing in the direction of the houses and villas on the height above our works, then, of course, the smell is noticeable on those days.

Dr. *William Odling*, examined by Mr. MICHAEL.

I am a Fellow of the Royal Society, and a Professor of Chemistry in the University of Oxford. For the last 20 years I have devoted very considerable attention to the question of gas purification and manufacture, and was one of the Gas Referees during the years 1873 and 1874. When gas is produced it contains gas in a form which may be described as sulphuretted hydrogen, and also as sulphide of carbon; it is not, chemically speaking, the latter, but that is the description generally. Sulphuretted hydrogen is a gas with an exceedingly offensive smell, and it exists to a very considerable extent in crude gas—I believe about 400 or 500 grains in 100 cubic feet, and the retention of that amount would be a very objectionable thing. It is very easily recognized by a test paper, if any is left in the gas. The gas ought to be supplied to the consumers absolutely free from sulphuretted hydrogen, and is so in that supplied by the London companies. A piece of bibulous paper is saturated in a solution of acetate of lead, and is kept constantly suspended over the gas in all good gas-works, so as to enable the engineer in charge at once to detect if any sulphuretted hydrogen exists in the gas, and records are kept of that test. In addition to the sulphuretted hydrogen, there is a proportion of sulphur existing in the gas which has not the property of affecting test-paper. In this residuary sulphur, which is generally spoken of as "sulphur other than sulphuretted hydrogen," there exists undoubtedly sulphur in the form of sulphide of carbon. In the Crystal Palace Gas Act of 1873, a maximum of 20 grains of sulphur compounds was allowed to remain in the gas, but it was to be perfectly free from sulphuretted hydrogen. There had been restrictions in the Metropolitan Gas Acts for years, but up to 1872 or 1873 there were no means known for reducing the sulphur other than the sulphuretted hydrogen to any extent at all. There is now only one process, so far as I know practically, and that consists in the use of lime in the manner described by Mr. Livesey and Mr. Stevenson, although a great many proposals have been made. I am aware that an experiment has been tried of introducing into the purifier atmospheric air, in order to see whether that would not to a great extent remove the nuisance complained of when the purifiers were opened, but I have not seen the operation. It would be difficult to say what is the extreme power of lime in reducing the quantity of sulphur other than sulphuretted hydrogen in gas, but I believe, in a practical operation, it will reduce the amount to about half. I think it is a matter of scarcely any importance whether there are 15 or 30 grains in 100 cubic feet. One hundred cubic feet of gas would weigh from 3 to 4 lbs.; therefore, if you have 30 or 40 grains of sulphur in 3 or 4 lbs., that would be about 10 grains in the pound; and if you halved that it would be reduced to about 5 grains in the pound, or if it is put as a per centage, the amount of impurity, which originally is one-seventh per cent, would be reduced to one-fifteenth per cent., and that is practically a matter of no consequence whether the gas is burnt in the open air or in rooms. In conjunction with Dr. Russell, I have instituted a series of experiments, in which gas has been burnt with a known quantity of sulphur, our aim being to have all the conditions which ordinarily exist. The room employed for the purpose was one of the offices of the South Metropolitan Gas Company, and the experiments have been going on for three or four months. The room was 18 feet 10 inches in length, 17 feet broad, and 12 feet high, and that would give a capacity of about 3800 feet. It had two windows and a door, and was furnished as an ordinary sitting-room, lighted by means of a chandelier, hung from the centre of the ceiling, having three lights fitted with Sugg's bat's-wing burners, at a height of 7 feet from the floor, and each of them burnt with great regularity 5 cubic feet an hour; they were also provided with governors and tested by meters. There was a moderate fire maintained in a grate to keep up the ordinary conditions, and the door was continually kept shut; but people came in and out as they pleased, and there were one or two persons usually in the room. The gas which we burned was some which had been prepared without having been purified with lime. It was tested 23 times, as I am informed by the official tester, who found it to contain, as the mean of his 23 observations, 33 grains of sulphur in 100 cubic feet. We lighted the gas some hours before beginning our experiments, and we ascertained, by a considerable number of experiments, that if the gas had been lighted for four or five hours the atmosphere of the room underwent no further alterations, either in chemical composition or temperature; but after four or five hours we got it up to the maximum of heat and impurity, and beyond that the continuous burning had no further effect. In commencing the experiment, measured quantities of air were sucked through aqueous ammonia, to absorb the sulphurous products, and we satisfied ourselves, by preliminary experiments, that in this way were absorbed the whole of the sulphurous products that were in the air—in fact, we used a very much greater amount, practically, of absorbing power than was necessary—and then were estimated the amount of sulphurous products. I also took the atmosphere after the gas had been kept burning continuously for 20 hours, and in some cases 48 hours, but there was no sensible variation. We took the air first of all from a height of 1 foot 6 inches from the ceiling; we had previously ascertained that the products of gas combustion aggregated very largely in the upper part of the room. Then we also took it at the height of about 5 feet 6 inches from the floor, which represents about a man's ordinary breathing height; and we took it at a height of 3 feet 6 inches from the floor, as representing a man's ordinary breathing height sitting down. At 1 foot 6 inches from the ceiling, the mean of three experiments, gave us 16 grains of sulphur in 10,000 cubic feet of air, or ·160 in 100 cubic feet. At 5 feet 6 inches we found the result rather less than at 3 feet 6 inches, but that arose from the fact that the latter series of experiments was a mean of three, whereas the 5 feet 6 inch series was a mean of two, by reason of an accident, one portion being thrown away. Those experiments were compared with that of a room in which the gas had been burnt for two hours, and in that case, whereas formerly we had 16 grains in 10,000 feet, we had now only 10 grains, but with reference to the 5 feet 6 inches and the 3 feet 6 inches there was no substantial difference. We also took the air of a room in which gas had not been burnt at all, and in place of the 10 grains we found there was only between one-tenth and two-tenths

of a grain. A minute quantity of sulphur is invariably found in the air, from the combustion of coal which is going on. The quantity of sulphur compounds found in the air would certainly not have any appreciable effect upon health or life; it only amounts to about one part in the third of a million up at the ceiling, and one part in about three-quarters of a million at the breathing height. There is no doubt that in rooms that are heated by gas, the hangings, books, and furniture, in the upper part of the rooms, do suffer very considerable deterioration, and it has been alleged that that is due to the sulphurous particles of the gas; but that, I say, is not the fact, for two reasons—first, other conditions are amply sufficient to account for it, and secondly, the sulphur itself is not capable of doing that amount of injury. The following are the results obtained by myself and Dr. Russell:—

Grains of sulphur per 100 cubic feet of air, found in the air of a room of 3800 cubic feet capacity, in which gas containing 33 grains of sulphur per 100 cubic feet had been burnt at the rate of 15 cubic feet of gas per hour for upwards of five hours continually.

	I.	II.	III.	Means.
At height of 1 foot 6 inches from ceiling .	0·184	0·123	0·173	0·160
At height of 5 feet 6 inches from floor. .	0·056	0·037	—	0·046
At height of 3 feet 6 inches from floor. .	0·058	0·032	0·085	0·059

Gas Burnt for Two Hours only.

	I.	II.	III.	Means.
At height of 1 foot 6 inches from ceiling .	—	0·135	0·076	0·106
At height of 5 feet 6 inches from floor. .	0·040	0·070	0·045	0·052
At height of 3 feet 6 inches from floor. .	0·039	0·050	0·037	0·042

Not any Gas being Burnt.

	I.	Mean.
At height of 1 foot 6 inches from ceiling	0·020	0·020
At height of 5 feet 6 inches from floor	0·010	0·010
At height of 3 feet 6 inches from floor	0·009	0·009

We find the air in the upper part of a room is prejudicial, in the first place, from its high temperature. After the gas has been burning in a room for four or five hours, we find that the temperature in the upper part, 12 feet high, would increase by some 20°, whereas the temperature of the breathing height will only increase some 5° in the course of a few hours. In using the three Sugg's burners, the illuminating power was about 50 candles. There is no doubt, when gas is burnt, that the products of combustion and heated air have a much greater tendency to concentrate themselves in the upper part of a room when the light is aggregated together than when the same amount of light is obtained from a number of small jets, as is the case with candles. The oppressiveness which people experience in rooms lighted with gas depends not only on the high temperature directly, but also upon the high temperature indirectly; because, having an accumulation of heated air at the upper part of the room, that part of the room is virtually cut off for the purposes of respiration. In the room in which we are now assembled, the hot breaths ascend into the air above; but if the room were cut off at the height of the door, we should find the room much more oppressive. If instead of the room being cut off at the door, it was filled with hot air, or so hot that it could not mingle with the lower stratum, the room would be virtually cut off at that height. By the combustion of gas there is a certain amount of water formed, and, therefore, the absolute amount of water in the air is increased relatively to the amount of water that the air is capable of taking up. It is decreased—that is to say, the air is less saturated with water after the gas has been burnt in it than it was before. This is shown by the fact that the wet bulb of the thermometer indicated a difference of 10° —there was that difference between the wet and dry bulbs of the thermometer near the ceiling, and only a difference of 5°, 6°, or 7° below. That showed that the upper part of the room was not only hot but dry, and that would have a great influence upon books, pictures, and various articles exposed to its influence. We also examined the gas with regard to the other impurities produced by combustion. The amount of carbonic acid existing in the open air may be taken at 4 volumes in 10,000 volumes. In the room in which we experimented, this proportion rose to upwards of 40 volumes near the ceiling, above the chandelier, and to 20 volumes below; that is to say, it increased ten times near the ceiling, and five times at about the respiration level. It is generally considered that the presence of a large amount of carbon in the atmosphere in any form is prejudicial to health and life. The volume of carbonic acid gas furnished by the carbon of gas coal may be taken as at least a thousand times greater than the volume of the sulphurous products produced by the burning of sulphur. Carbonic acid has no smell; and everybody knows that on going into a gas-lighted room there is a certain amount of smell and chokiness which is not due to carbonic acid at all, but it has long been attributed to the products of imperfect combustion. If gas is burnt in a room where the amount of air and gas are not exactly regulated, either the gas is under-burnt or over-burnt, and in either case strong-smelling offensive products are formed. We have taken some trouble—I believe for the first time—to get some idea of the proportion of these products, and they are, I may say roughly, that where the amount of carbonic acid in the air of the room has been so far increased as to amount to from 1½ to 3 grains in a cubic foot, we find those other impurities resulting from the imperfect combustion of gas—which give rise to that choking sensation—amount to from half a grain to a grain in a cubic foot in addition. The difference between 20 grains and 40 grains of sulphur would not alter the carbon compounds in any degree whatever. If a room is properly ventilated, a small proportion of sulphur does no harm in any way; but if it is not properly ventilated, the removal of it will do no practical good, by reason of the large amount of carbon products. We know that so much sulphur is capable, when it is burnt in a certain way, of yielding so much sulphuric acid, and it may be taken that the amount of sulphur contained in the gas which would be burned in an ordinary room in the course of a week, is an amount which would be capable of yielding enough sulphuric acid to destroy all the furniture; but the fact that the furniture does not get destroyed in a week, a month, or a year, shows that that amount of sulphuric acid is not the point at issue, which is to determine the amount of sulphuric acid, if any existed, in the room in which gas was being burned; all other modes of determination have no bearing upon the question. I am quite of the opinion that the removal of the restriction which exists will not enure to the disadvantage of the public. With regard to the alleged injurious effects of this small proportion of sulphur, it is not the result of observation, but it is the result of a notion that it must produce sulphuric acid when it is burnt, and that sulphuric acid, when it is burnt, is a very dangerous thing. I say that the evidence that this is not the case, is shown by the fact that sulphur is very largely used for bleaching silk and woollen goods, and also for the purpose of disinfection—not merely sulphur as sulphur, but sulphides of carbon. It is common to burn a quarter of a pound of sulphur per 1000 cubic feet of space, so that in the very room in which we were experimenting, they would burn about a pound of sulphur, and burn it till the air became so opaque, it could not be seen through. The room would be closed for a couple of hours at least, and then the windows would be opened, and the room ventilated, and the furniture would be found not to have suffered any inconvenience; and that would show that any injury experienced by rooms in which gas was burned was not due to the exceedingly minute proportion of sulphur contained in the gas. Taking the maximum quantity of sulphur which we find in the room in which we now are, a person would have to go on breathing for six or eight hours in order to take into his lungs, in the course of respiration, as much as the twentieth of a grain of sulphur, from which no bad result would follow. Supposing no other process than oxide of iron were used, so far as sulphur is concerned, I am not prepared to say what would be the maximum quantity of sulphur left in the gas, but on an average it would amount to about 30 grains, or a little over. No other purifying material than oxide of iron is used in Manchester, Birmingham, or Liverpool, nor yet Paris, and that has been adopted after considerable inquiry as to whether or not other means should be adopted.

Mr. MICHAEL: We have it from Mr. Livesey's own observation; but the general question I wish you to satisfy the committee upon is this: Supposing oxide of iron to be used as a means of purification, under any circumstances, do you know whether there would be any prejudicial amount of sulphur other than sulphuretted hydrogen in the gas?

Witness: No; and I base that partly upon all these observations and experiments, and partly on the fact that it is not found to be prejudicial in such towns as Paris, Liverpool, and Birmingham.

Cross-examined by Mr. CRIPPS: My experiments have all been made for the Crystal Palace District Gas Company.

Mr. CRIPPS: Your experiments go to filling the room once with gas, and then trying the results; but you would hardly compare that with the case of a room where gas was burnt continually every day and every night for years and years?

Witness: Of course every day would add to the injury. My experiments were made in a room 12 feet high, but taking London, the rooms in artisans dwellings are generally very much lower than that. I think there is a distinct difference between the air which is above the chandelier, if there be one, and that which is below. There is no absolute impossibility to supply gas with less than 20 grains of impurity in 100 feet, but it is entirely a question of expense—to use a common expression, whether it is "worth while."

Mr. CRIPPS: Do you really suppose that the public of London, who know that they have been protected for years past from impurities, will be satisfied when they find the alteration has been made?

Witness: I should say there is not the slightest proof as to the presence of sulphuric acid.

Mr. CRIPPS: But the sulphurous acid may become sulphuric acid by the addition of another element, oxygen?

Witness: With so much sulphur, if you please you may make so much sulphuric acid; the only question is whether it exists in a room lighted by gas.

Mr. CRIPPS: But what they are breathing and what they are having enter their rooms may be ultimately sulphuric acid?

Witness: No; I dispute that.

By the COMMITTEE: Sulphurous acid would become sulphuric acid by the admixture of oxygen. There is abundance of oxygen to supply it; the point is whether the amount of sulphur that is found in the room actually gets converted into sulphuric acid or not. I say the thing is quite conceivable, but the question of whether it does or not can only be tried by experiment.

The COMMITTEE: You mentioned the burning of a pound of sulphur; how long a period of continuous gas-burning would that represent?

Witness: A pound of sulphur would be 7000 grains. It would require about 20,000 feet of gas to yield that amount of sulphur, and at the rate of 15 feet per hour would have to burn for over 1200 hours. I only made that statement as an illustration that there might be a very great amount of sulphur in a room, and that that sulphur was a product which did not damage the fabrics.

Re-examined by Mr. MICHAEL: Those experiments were conducted over a period of three months. A person standing in a low room would suffer more from the defilement of that room by gas products; but this defilement is not attributable to the sulphur compounds, but the carbonic compounds.

Mr. MICHAEL: Therefore, as far as sulphur is concerned, it being nothing, if you multiply nothing by any amount it remains nothing still, but when you take the other defilement from merely burning the gas—the carbon compounds and the other matters producing defilement of the atmosphere —of course, the less the amount of that dilution the greater the injury produced?

Witness: Yes. As regards the general result of my own observations I should say that of the very small proportion of sulphurous products which are produced, about one-tenth part of that small proportion is converted into a state of sulphuric acid, and that is in a large measure neutralized by the ammonia existing in the air, and would become sulphate of ammonia, and this being a neutral salt, no injury would occur from that small quantity being present. If anything like the amount of sulphur that was in the gas was converted, by burning, into sulphuric acid—if more than a mere trace was so converted—it would not be a question like the present before the committee, because it would be found that the furniture would be destroyed. It would practically result in this—that no gas could be burnt in a room which was not thoroughly ventilated, whereas we know that gas is burnt in rooms in which there is a total absence of ventilation.

By the COMMITTEE: I have not tabulated the results as to carbonic acid, but I can state them generally. Near the ceiling we got 40 parts in 10,000, and at the breathing height 20 parts in 10,000.

The COMMITTEE: Would these particles of carbonic acid, however formed, not produce any smell or disagreeable influence upon the nostrils or lips?

Witness: Actually carbonic acid itself does not, but these other products of imperfectly burnt gas, and these other carbonaceous products, do.

Dr. *William James Russell*, examined by Mr. PAULI.

I am a Fellow of the Royal Society, and Professor of Chemistry at St. Bartholomew's Hospital. I have been generally engaged with Dr. Odling in making these experiments, to which he has spoken. I have also heard his evidence, and agree with him in all respects. I believe that the unpleasant effect in rooms does arise from those carbon compounds, and that sulphur has nothing to do with it. We did not appreciate the presence of sulphur, although it would be very easily traceable.

Mr. PAULI: You would have found out, by your experiments, whether there had been carbonic acid or not?

Witness: No, we should not, as far as our experiments went; they would apply more to those sulphurous compounds, or sulphuric acid. The means we took to collect it would have collected it whether it was sulphurous acid or sulphuric acid. Any quantity of either of those acids would exercise a very prejudicial effect upon the leather of bookbinding, and so on. I have heard that great damage has been attributed to the sulphur compounds in gas, in libraries and other places, but I do not believe it is owing to those compounds.

Mr. PAULI: Do you believe it would be any practical benefit to the public at all that the sulphur compounds in gas should be reduced, we will say to 20 grains in 100 cubic feet?

Witness: I do not think they would be able to tell the difference in the least.

Mr. PAULI: Do you agree with Dr. Odling in the infinitesimal amount of these sulphur compounds which you would have to breathe?

Witness: Yes. I think our experiments really show that one would have breathed the tenth of a grain of sulphurous acid into the system, assuming that the whole of the sulphurous acid that went into the system remained there, which would not be the case. With reference to those experiments, our principal object was to get a room which should be as similar as possible to an ordinary room in London. I confirm the evidence of Dr. Odling with regard to the general results of those experiments.

Cross-examined by Mr. CRIPPS: I do not know that there is any reason why proper ventilation should never be ensured in the dwellings of the lower classes; there is no practical difficulty about it. The same thing might be said with regard to the dwellings of the higher orders.

Re-examined by Mr. MICHAEL: Sulphuric acid in a concentrated form is a very corrosive substance, and if it were brought out in that corrosive form in the ordinary process of burning gas, we should find in every room traces of its presence. All the goods would be spotted over with it, and holes formed in them. The carbon compounds ought certainly to be got rid of by ventilation, but that is beside the mark when we are discussing the presence of sulphur as an injury.

Mr. MICHAEL: If the ordinary process is adopted of purification with oxide of iron, would there be left such a quantity of sulphur in the gas as would lead to injurious results when that gas was burnt?

Witness: I think not.

Mr. MICHAEL: Therefore it is useless to resort to the process of purification by lime?

The CHAIRMAN: I think Dr. Russell says he agrees entirely with the last witness.

Mr. CRIPPS: They would not think of burning gas in any quantity in the wards of St. Bartholomew's Hospital, would they?

Witness: I should think so.

Mr. CRIPPS: Are they not very particular to have one burner in a ward and the window open?

Witness: I really do not know what the arrangements of the hospital are, but I hope they adopt what you suggest—good ventilation.

Mr. MICHAEL: Supposing they do, has that any reference to the quantity of sulphur in the gas?

Witness: I should say not. The object of ventilation is to get rid of the products of combustion in the heated air.

The COMMITTEE: Can you give any idea what is really the difference between sulphuric and sulphurous acids, in regard to their deleterious effects, if any?

Witness: Sulphuric acid is the stronger of the two, and would turn out sulphurous acid, while sulphurous acid would not turn out sulphuric acid.

Dr. *Thomas Stevenson*, examined by Mr. MICHAEL.

I am an official gas examiner, and also a Professor of Chemistry at Guy's Hospital. I have heard the evidence of Dr. Odling and Dr. Russell, and concur in that evidence. I believe I first introduced the use of bisulphide of carbon as a disinfectant, and I have used it exclusively for the disinfecting of rooms in the portion of the Metropolis in which I have been Medical Officer of Health for the last six years. I have used, not pounds, but half a ton in that time. Bisulphide of carbon is a compound of carbon and sulphur, made by passing sulphur over heated charcoal. It exists in the form of a transparent liquid, which is highly volatile and inflammable. When using it as a disinfectant, it is simply placed in an open dish in quantities varying, according to the size of the room, from about one-fourth of a pound to half a pound at a time; a match is then applied, and the vapours and the liquid are allowed to burn. A small quantity comparatively of carbonic acid is produced, and a very large amount of sulphurous acid, so that in a few moments no one can stay in the room so as to breathe. The room is then shut up, and left in that way for several hours, and then the doors and windows are thrown open, and the room can then be occupied; this is done after infectious disease. That sulphurous acid is in contact with the oxygen of the atmosphere.

Mr. MICHAEL: Is it under precisely the same circumstances as the sulphurous acid which may be formed from the combustion of the gas with the sulphur compounds in it?

Witness: Yes; the only difference is that it is in a larger quantity in the room when you burn bisulphide of carbon. I have made experiments with the sulphur in gas, and I find that on burning the gas only about 5 per cent. of the sulphur in the gas, as determined by the Referees apparatus, is directly converted during combustion into sulphuric acid, and that most of that sulphuric acid is neutralized by the ammonia present in the gas and in the atmosphere. During the six or seven years I have employed bisulphide of carbon, we have had only one claim for compensation for destruction of any article in the room, and that was bleaching an artificial flower and a bonnet, the sulphurous acid being a bleacher. I have had no claim for compensation of any kind for the corrosion of articles.

Mr. MICHAEL: This unfortunate artificial flower, if sulphuric acid had been formed, I take it, would have been destroyed by the corrosive action of the fluid upon it?

Witness: I think it would, and I also think we must have had a large amount of destruction prevailing everywhere, in furniture and so on, if any appreciable amount of sulphurous acid had been converted into sulphuric acid.

Mr. MICHAEL: Of course there was a very much larger quantity of sulphurous acid formed than there possibly could be created by burning gas with any amount of sulphur?

Witness: Yes. I should like to add that there is one condition which would determine the conversion of sulphurous acid into sulphuric acid, which is absent in rooms, and that is the presence of an excess of ammonia in liquid, which is an essential condition for the rapid conversion of sulphurous acid into sulphuric acid. That is not present under ordinary circumstances in burning gas. There is an inappreciable amount present of ammonia.

Mr. MICHAEL: Have you ever seen any bad results from the combustion of gas containing sulphur which could be traced to sulphur compounds?

Witness: None which could not be traced to other conditions developed during the burning of the gas, those conditions being increased temperature, increased dryness of the atmosphere, and increased products of combustion, carbonic acid, and so on. I have a table here, which will confirm Dr. Odling:—

DR. THOS. STEVENSON'S EXPERIMENTS ON HYGROMETRY, &c., IN ROOMS IN WHICH GAS IS BURNT.

1. *Drawing-Room.*—11 feet 3 inches high. Capacity 3000 cubic feet. Occupied by two adults. Fire. Three bat's-wing burners, each consuming 4 cubic feet of gas per hour. Gas burnt for 4½ hours before testings were made.

	18 In. above Floor.	4 Ft. above Floor.	1 Ft. below Ceiling.
Temperatures	61°	65½°	79½°
Relative saturation of air with moisture; total saturation = 100	69	55	46
Volumes of carbonic acid in 10,000 volumes of air	—	7·70	44·2
Grains of water required to saturate 1 cubic foot of air with moisture	1·53	3·10	5·87

2. *Dining-Room.*—11 feet 3 inches high. Capacity 3500 cubic feet. Occupied by two adults. Fire. Three bat's-wing burners, each consuming 5 cubic feet of gas per hour. Gas burnt for 4½ hours before the testings were made.

	3 Ft. above Floor.	7 Ft. 9 In. above Floor.	1½ Ft. below Ceiling.
Temperatures	61°	68°	77°
Relative saturation	60·5	58	44
		8½ Ft. above Floor.	
Volumes of carbonic acid in 10,000 vols. of air	18·6	35·0	
Grains of water required to saturate 1 cubic foot of air with moisture	2·36	3·15	5·59

3. The last (dining) room, lighted with three good oil lamps on table. No gas.

	5 Ft. above Floor.	7 Ft. 9 In. above Floor.	1½ Ft. below Ceiling.
Temperatures	66½°	64°	68°
Relative saturation	61	54·5	45
Grains of water required to saturate 1 cubic foot of air with moisture	2·87	3·59	4·57

PROPORTION OF SULPHURIC ACID TO TOTAL SULPHUR OBTAINED BY BURNING COAL GAS FROM A BUNSEN BURNER.

1. *The Gaslight and Coke Company's Gas.*

Total Sulphur in 100 Cub. Ft. of Gas.	Sulphur as Sulphuric Acid from 100 Cub. Ft. of Gas.
14·66	0·97
19·07	1·09
19·45	0·74
16·32	0 91
16·07	0·84
Averages 17·11	0·91 or 5·32 per cent. of total sulphur.

2. *Surrey Consumers Company's Gas.*

Total Sulphur in 100 Cub. Ft. of Gas.	Sulphur as Sulphuric Acid from 100 Cub. Ft. of Gas.
23·00	3·81
38·35	1·44
38·86	1·82
39·24	0·27
55·38	1·44
Averages 38·97	1·90 or 4·87 per cent. of total sulphur.

QUANTITIES OF COMBINED AND FREE SULPHURIC ACID CONDENSED ON GLASS PLATES AND ON CALICO AFTER 24 HOURS EXPOSURE IN GAS-LIGHTED ROOMS.

1. *Plates Clean and Dry.*

Sulphur in Gas used in Grains per 100 Cub. Ft. of Gas.	Size of Room in Cub. Ft.	Quantity of Gas Burnt per Hour.	Total Sulphuric Acid, Free and Combined, Deposited on 1 Square Foot of Surface in 24 Hours.
19·07	2016	10	·020
35·75	3840	15	·003
36·02	3840	15	·006
33·70	3840	15	·006
39·60	3840	15	·016
			·010 average.

2. *Plates Moistened with an Alkali (Carbonate of Sodium).*

19·07	2016	10	·068
36·02	3840	15	·055
39·60	3840	15	·042
23·65	3840	15	·039
36·83	3840	15	·252
—	3840	15	·214
—	3840	15	·201
			·124 average.

3. *Clean Calico (Six Days Exposure).*

34·00	3840	15	·380
34·00	3840	15	·290
			·330 average.

It thus appears that only 8 per cent. of the sulphur in the air is deposited on plates not covered with an alkali—*i.e.*, in their natural condition.

The quantity of *free* or *corrosive* sulphuric acid deposited was too small to admit of accurate determination.

I find the same conditions are not present when I light the room with lamps as with gas, because so much absolute amount of light is not required when lamps are used. When you use gas you burn it in a chandelier in the centre of the room, but when you use lamps or candles you place them near where they are wanted on the table. There is also another thing—viz., that gaslights are usually clustered together, and form a strong ascending current of highly heated and light air, which ascends to the top of the room, and there remains practically fixed at the level of about the doorway, or a little above, so that the whole atmosphere about six inches above the down outlets is practically a heated, dry, and foul atmosphere, cut off from ventilation from the upper part of the room, and very destructive, no doubt, to all articles—books, and so on—which are exposed on the upper shelves of a library. Such an amount of carbon compounds in the atmosphere as I have mentioned would be injurious to health, and would show that ventilation was required, not on account of the sulphur products, but on account of that carbon matter. I have determined also the amount of condensation of those different products, and I find it was very small indeed.

By the COMMITTEE: I have exposed glass plates, and also clean washed calico in various parts of the room where gas has been constantly burnt—one of the rooms being the same as that used by Dr. Odling—and I find that the amount of sulphur deposited on those objects is exceedingly small. The total amount of sulphuric acid deposited was, on an average, per square foot of glass, after 24 hours exposure, only 100th of a grain, and that was nearly entirely in the non-corrosive form of sulphates. As Medical Officer of Health, I complained of the nuisance created in the King's Cross district by the use of lime. I called upon the company to abate the nuisance, and I went thoroughly into it, being at that time advising Mr. Patterson as to his patents.

Mr. MICHAEL: Did you not institute some experiments as to the ventilation of the lime purifiers in order to get rid of the nuisance?

Witness: I called upon the secretary of the then Imperial Gas Company.

Mr. CRIPPS: That is the general company.

Witness: The company carried out some experiments in the ventilation of the purifiers. I did not see them carried out, but I saw the result of passing air through them, and they were most disastrous. They made a far worse nuisance, and damaged the purifiers.

Cross-examined by Mr. CRIPPS: Those experiments were carried out at the Bromley works, but they did a great deal of mischief, and had to be modified; there was an injunction against them. I am not personally acquainted with the Beckton works. There has been a general tendency to remove gas-works from among the populations to places where it was supposed the nuisance would not do much harm, but there are still some remaining in the central parts of London.

Mr. CRIPPS: You have stated that where gas has been burnt there is

something deleterious, which you think can be accounted for by its being dry, hot air?

Witness: Dry, hot, foul air, but not foul from sulphur.

Mr. CRIPPS: There must be some compound arising from gas manufacture besides the mere heat and dryness, in order to produce the effects which you state.

Witness: Not from gas manufacture, but from gas combustion. I think the sulphurous acid is so small that it is quite inappreciable—something like one part to 1000 parts of the carbon products. That sulphurous acid is capable of becoming, by the intermixture of oxygen, sulphuric acid, but that is a very slow process, unless you have an alkali present.

Mr. CRIPPS: However slow it may be, it does become sulphuric acid?

Witness: If it is not removed; but it does not remain for a sufficient length of time in the upper part of the room to become an appreciable amount of sulphuric acid. If it did remain there, and there was no further ventilation, it would become sulphuric acid after a very long exposure—perhaps weeks.

Mr. CRIPPS: After the gas had gone on burning for weeks and months together?

Witness: Yes; but then you have at the top of the room an atmosphere which practically, after four or five hours, becomes uniform, and then we may take it that as much new products of the combustion of the gas are thrown in as old ones removed. Practically the amount of foulness is not going on accumulating, but represents an uncertain quantity.

Re-examined by Mr. MICHAEL: Gas is ordinarily burnt for a certain number of hours, and then for a much greater number of hours it is not burnt. I find from experiments that, in the course of a few hours—say five or six, or even less—if the room is well ventilated, it resumes its ordinary condition in which it was before the gas was burnt. I have found that in a small ill-ventilated room, on turning out the gas and leaving the door ajar, and going in the morning and testing the atmosphere again, it was practically the same as the day before, previous to the gas being lighted.

The COMMITTEE: Are we to understand that when the air at the top of the room is charged with a certain amount of this sulphurous compound, whatever it is, that it does not become any more charged, no matter how long the gas may be burning? Does the air give it off, or does it sink down to the floor; or what happens?

Witness: No doubt a small portion escapes by the ordinary channels of ventilation, if there are any in the upper stratum, and part of it passes into the lower stratum of the atmosphere; and just as much of the foul products in the upper stratum of air as passes down into the lower stratum will pass upwards from the products of combustion.

The COMMITTEE: Do you mean to say that the air is not capable of carrying or of containing at that rate more than a certain charge of these compounds?

Witness: No, I do not exactly mean that; but as the particles of combustion pass to the upper stratum of the atmosphere, they must turn out some of the old stuff that was there; and that just as much as is turned out or displaced in the upper stratum is raised from the lower stratum. It is just like a cistern tap with water running in—as much water must run over the top of the cistern as runs in from the tap. At the works near King's Cross, being in a populous part, they are allowed 5 grains more sulphur per 100 cubic feet than they are allowed at Bromley, and I believe the object of that is to keep down the nuisance.

Mr. *James Layton*, examined by Mr. PAULI.

I am a bookbinder, residing in Brewer Street, Golden Square. I have devoted a great deal of attention to finding out the best mode of preserving the binding of books. In 1843 there was an inquiry at the Athenæum Club with respect to the bad state in which the bindings of their books had got, and I was called upon to investigate the circumstances. The result was that I found there was absolutely no difference in the condition of the books in a room in which gas was burnt, and the condition of similar books in rooms in which no gas was burnt at all. After paying a great deal of attention to the matter, I came to the conclusion that the state of the books was attributable to the extreme temperature at the top of the room. In the north library there was no gas burnt, and the state of the bindings in that room were even worse than in some of the others in which gas was burnt. The temperature of that room was very high, owing to the flues of the kitchen, and the obvious conclusion was that those books went bad entirely from the excessive heat. I am also binder to the Royal Institution. Gas is there burnt continually in the reading-room, but there are very few books there. In the library they have gas occasionally—the secretary tells me about 19 nights in the year, not more—but the books there are in a very bad condition, the upper part particularly. They are quite as bad as in libraries where gas is burnt continuously. [Witness handed in a specimen of the state of the binding of many of the books from the library of the Royal Institution; another one from the library at the Travellers Club, where there is no gas burnt at any time.] I was acquainted with the Duke of Norfolk's library in 1863. There were two rooms—one the library below, and a room in which books were kept next the roof. There was a very great difference in the temperature of those two rooms. In the summer time, with the sun shining on the roof, the top room was very hot. The books in the lower library were in a very good condition generally, and suffered very little, but those in the top room were very dry and perished, and on removing them the binding would often break off. There was no gas in either of the libraries.

Mr. PAULI: Then I suppose the general conclusion you came to was that the burning of gas in a room has no practical bearing upon the condition of the books, but that the condition of the books was due entirely to the temperature?

Witness: No further than this, that gas, I think, is a great source of heat; I find it hotter where gas is burnt.

Mr. PAULI: But the decay in the books you attribute to the immense temperature? You have shown pretty conclusively that the presence or absence of gas has nothing to do with it?

Witness: It is the dry atmosphere, I think.

By the COMMITTEE: The temperature at the Travellers Club is generally very high, they being gentlemen who have been a great deal in the East, and they like the warmth.

Mr. CRIPPS said he should not cross-examine the witness on the present case.

Mr. MICHAEL said he should not trouble the committee with any further evidence.

Mr. CRIPPS said he should have very few remarks to make on the present case. It would be obvious to the committee that the question of the Crystal Palace Gas Company was no more to the Metropolitan Board of Works than the question of any other particular district within their jurisdiction. It so happened that a small portion of the Crystal Palace district was within the jurisdiction of the Board, and it also happened that the Bill next to be brought before them affected nearly the whole portion of the district under their jurisdiction. The question, so far as they were concerned, was to protect generally the interests of the gas consumers throughout the Metropolis, and it was quite obvious that the proper course for the Metropolitan Board to take was as follows:—There were parties applying for a privilege which the Metropolitan Board and the consumers believed would be detrimental to them, and, on behalf of the Board, it was desirable to hear all the evidence given in favour of that charge. It was a very heavy onus which the companies were taking upon themselves. It might be that they would be able to prove the case they had undertaken; but as there would be a large body of evidence, scientific and otherwise, to be given in opposition, he (Mr. Cripps) asked, on behalf of the Metropolitan Board, that the decision on the present case might be reserved until all the evidence on the general case had been given. It was true that the counsel would not be the same in both cases, but there were representatives, and they would be perfectly able to represent the whole case when it came before the committee. The question of the gas supply of the Metropolis had been a matter of agitation between the gas companies and the consumers for a considerable number of years. Unfortunately, they had not felt their interests always to be identical, although they really were so, and would ultimately turn out to be so. There was no one a gas director looked upon with more suspicion than a gas consumer, except it was the Metropolitan Board of Works, who, as representing the consumers, were looked upon as worse than the consumers themselves. The consequence had been that, for some years past, a considerable contest had been going on, commencing from 1860 to the present time. A number of Acts of Parliament had been passed, conferring powers on one side or the other, all of which had been more or less compromises of the views of the two parties. In 1860, which was the inception of the matter, and the first Act in which the limitation of 20 grains of sulphur in 100 feet appeared, the gas companies rather than the Metropolitan Board originated the agitation which led to that Act. The companies obtained a very great advantage in that year, which should not be underrated on their part, which was that the Metropolis was divided into different districts, and a supply was given to a particular company, and appropriated entirely to that company, so long as they were able to supply the district, and so long as an inquiry before the Home Office, or something of that kind, did not alter it. Of course there were certain restrictions placed upon the companies, amongst which was the restriction that their gas should be free from sulphur compounds to a greater quantity than 20 grains in 100 feet. The Crystal Palace District Gas Company were not at that time sufficiently within the Metropolis to make that Act applicable, and they were exempted from its operations. In the meantime, the district, like all other districts round London, became more and more metropolitan. Ultimately, in 1873, the Crystal Palace District Gas Company applied for power to raise £150,000 at 7 per cent., which capital, under the Gas-Works Clauses Act, was to be offered in the first instance to the holders of the old shares. In return for that great benefit, the company had to submit to the likening of their district to what was common in other parts of the Metropolis with respect to the sulphur impurities, and they were limited to the 20 grains per 100 feet. That was the contract entered into with the consumers, and it was upon that the consumers rested their case. They said, "We allowed you to have certain benefits upon your incurring certain restrictions for our benefit. We made a great point of our desire to have the gas purer than it was before. You submitted to that, and you have gone on now for a certain number of years supplying gas of that purity, subject to penalties if you do not supply it, and you take a very heavy onus upon yourselves in coming to alter the bargain which you entered into with us at the time."

Mr. COURTNEY: You do not present it in that way. Your petition says it was a mutual bargain which had been paid for.

Mr. CRIPPS said one did not want to put everything in a petition. He was entitled to rely upon the whole case.

Mr. COURTNEY: You are here only to raise it upon the question of health—upon a sanitary question.

Mr. CRIPPS said that was a point he was coming to, but he was then viewing it generally, and therefore was entitled to take any objection. The undertaking the company gave had been carried out from that time till the present, but now they asked to be relieved from that responsibility, on the ground that it was impracticable to do it. They did not say, "We cannot give the gas pure," but all they said was, "It is an expense, and is inconvenient to us," and made them very unhappy; but were those real reasons? If it was any real injury to the company it could be proved, but they continued to divide their maximum dividends. They alleged it was an injury to the consumers, because if they could make their gas cheaper they could supply it cheaper, and every extra penny they paid for the extra purity fell on the consumers. Be it so. The consumers did not ask to be relieved from it. They preferred pure gas, and paid for it, and did not desire any alteration. Then they said, "Oh, but it compels us to make a nuisance at our works;" but that was very indefinitely proved. It was very true that at the present time where the Crystal Palace works were was much more surrounded with houses than places where gas was generally manufactured in the Metropolis, but what did that amount to? Of course, if a nuisance was created at those works the company could be indicted for that nuisance the same as anybody else could be. But what was the evidence of that nuisance? There was a small memorial, signed by about a dozen persons, which was presented about two years ago with reference to what was being done at those works, and all that the memorial suggested was that the company should adopt some other way of taking away the impurities in a closed conveyance rather than in the way they were doing. What did the chairman say? He said, "We took it away in carts for some time, but now there is a great improvement. The trucks of the company come to the gas manufactory and take away the products direct; but we do not attempt to cover over the trucks." Surely, if the matter were so urgent, they could, at no very great expense, have some trucks made specially for that purpose. Of course, they ought to be so constructed as to be covered, and so prevent any nuisance; but even as it was, since they had adopted that plan there did not appear to have been any complaints at all—certainly none had been proved. The committee had simply the statement that it would be less expensive to the company if they had not to use that method. Under those circumstances, was there anything proved as a reason why the bargain of 1873 should be reversed? They had heard a great deal of evidence that it did no harm to have the 20 grains of sulphur, but surely the consumers were judges of that; it was purely a consumers question. It was not for the gas company to say, if the consumers desired to have that impurity, "You are mistaken, and are taking an unreasonable view." They might try to persuade a person that there was no harm in the gas he was breathing from time to time; but if he felt that there was, and if he did not desire to have any impurity introduced from which he was free, surely that was for the consumer. Mr. Livesey had told them it could be done, and also that during the very last quarter the amount had only been 17 grains in 100 feet. There was no difficulty in the matter; it could be done, and had been done, and the inhabitants of the Metropolis had had the benefit of it; and now, because of some doubtful evidence (for what could be more doubtful than those laboratory experiments about sulphuric acid?) was the whole Metropolis to be told they were to have gas more impure for the future, because they were asked to remove that restriction of 20 grains, whether the proposition in the present Bill was to be 30, or 40, or anything else?

The CHAIRMAN: Altogether removed?

Mr. CRIPPS said it was a simple repeal, so that whatever quantity of sulphur might be contained in the gas they were to submit to in future. In

all probability the quantity of sulphur would depend upon the coal that was used; and if it should turn out to be 60 or 70 grains, the answer of the company would be, "We have gone to Parliament, and they have expressly repealed, upon evidence, your protection; therefore, however great the impurity may be now, you are not entitled to make any difficulty about it. Your time was to have gone to Parliament, and you had the opportunity of asking the committee not to pass the Bill. They have passed it, and you must now submit to that impurity, whatever it is." He (Mr. Cripps) would not at that time deal with the scientific evidence, because it would be obviously foolish to detain the committee twice over upon a question of that kind; but as the matter stood, had the company shown that it was a perfectly safe thing to repeal the restriction imposed upon them? If not, it unquestionably ought not to be removed. The whole proof was upon them to accept the restriction in return for benefits conferred upon them by the consumers. Was there anything sufficiently certain and definite shown that the gas consumers would not be prejudiced if a considerably larger quantity of sulphur was introduced into the gas? Sulphuric acid, no doubt, was generated by combustion. The amount of that, and the degree in which it was injurious to health, was very doubtful; and the witnesses said that in their opinion—and it was only a matter of opinion—it would not produce any inconvenience. On all those matters, science, even at its very best, was most uncertain; because, after all, it was not the quantity, however infinitesimally small any matter might be, which was detected by the experiment in a particular form, which was necessarily not injurious. Unquestionably, from the evidence as it stood, it appeared that in the gas supplied there was something very injurious, particularly at the top of the rooms, or at a certain height. Some persons thought it was carbonic acid; some thought it was something dry and hot at the same time. It might be that particular matter which they desired to have excluded; and when the height of rooms was spoken of, surely those who represented the consumers must be taken as representing all classes. In some cases, perhaps, persons were so careful of ventilation by modern appliances that the difficulty might be prevented, but that did not apply to the mass of consumers, who lived in small houses, and in rooms which were necessarily very imperfectly ventilated. Without detaining the committee longer, he (Mr. Cripps) could not help thinking that no case had been made out why the Bill should be allowed to pass, or why that which had been the law of the Metropolis for 17 years, and had prevailed against this company since 1873, was to be repealed in spite of the wishes, and against the remonstrances of the consumers of gas, who were the real parties to be looked to in any legislation on that matter. It was really a consumers question, and on behalf of those consumers, who were represented by the Metropolitan Board of Works, he decidedly asked the committee not to pass the Bill.

The CHAIRMAN (addressing Mr. O'Hara) said that Mr. Cripps seemed to ask the committee to decide at once that the preamble had not been proved, but they did not think they could do so, and therefore it would be necessary to go into the case somewhat more fully than Mr. Cripps had done. From the way in which the Bills had been brought on, the committee felt themselves bound to hear the present case upon its merits, and to decide it without waiting for the evidence and the arguments in the next case; but if the parties could make any arrangement by which the evidence taken in the present case could be made use of in the next, it would be a great convenience, and would save time and expense.

Mr. O'HARA expressed a wish to consult with his clients (the Metropolitan Board), and after a short conversation the committee adjourned.

WEDNESDAY, MAY 2.

Mr. *Charles Heisch*, examined by Mr. O'HARA.

I am a Fellow of the Chemical Society, and the superintending Gas Examiner to the Corporation of London. For 24 years I was Professor of Chemistry in the Medical College of St. Thomas's and Middlesex Hospitals. During that time I have been much engaged in the examination of coal gas and its impurities. Under the Metropolis Gas Act, 1860, the limit of sulphur impurity was fixed at 20 grains in 100 cubic feet. By the City of London Gas Act, 1868, which was originally intended to apply only to the City, but was afterwards extended to some other companies, the duty of determining with what degree of purity gas should be supplied is in the hands of the Gas Referees, who are directed to fix such a maximum as the companies can comply with without creating a nuisance in the neighbourhood of their works. At the present time—*i.e.*, from April to September—they have prescribed 20 grains for works situated near habitations, and 15 grains for those which are more removed. The Crystal Palace District Gas Company are, by their Act, required to supply gas with not more than 20 grains of sulphur, and I think if that restriction were removed entirely, it would be a considerable injury to the consumers. Before 1868 the condition of the gas delivered in London was very variable indeed. Before 1860 I do not think any records were kept of the amount of sulphur impurity present in the gas. The Act of 1868 came into operation in January, 1869, but the Referees were more than two years before they fixed the maximum. I think it was fixed somewhere about April, 1872. For the winter half of 1872-3 it was fixed at 20 grains for suburban works, but no quantity was named for urban works until June, 1873. That was owing to the fact of the Referees being engaged in making experiments, and to give time to the gas companies to make certain alterations which they considered necessary. During that period, the sulphur impurity delivered by different companies varied very considerably. The Great Central, whose works were situate on Bow Common, delivered gas which may be roughly said to have contained an average of something like 12 grains of sulphur in 100 cubic feet. The City Company were higher, going up frequently above 20 grains. They seldom got up above 23 or 24. Sometimes there was a run up to 30, but very seldom. The Gaslight and Coke Company's gas, as tested at Leadenhall Street, generally had an average of from about 32 to 38 grains; and when the Beckton Works were opened, the averages were, during the month of January, 1872, 44·8, and during the month of February, 44·9, and during the month of March, 37·9. Then were was a sudden fall—the average for the next month being 22·9. Then it went up again somewhat to 37 and 38, and just about the time when the maximum was fixed it went down again; in June, 1872 it went down to 12·6, and the next month it was 12, and so on. That was after the fixing of the maximum by the Referees; but when the works at Beckton were first opened, they for the first three or four months averaged from 35 to 45 grains.

Mr. O'HARA: Is the presence of sulphur injurious to property?

Witness: I believe it to be very much so.

Mr. O'HARA: Will you explain your views upon that subject to the committee?

Witness: I believe it to be injurious to property in this way: Although the quantity of sulphur is exceedingly small, yet burnt in the way that it is in gas it is not oxidized in the same manner exactly as it is when it is burnt in a dry state. Very large volumes of water, or of the vapour of water, are formed at the same moment as the sulphur is oxidized from the combustion of the hydrogen in the gas. Now, it is well known that if you burn sulphur, even in a damp atmosphere, a certain portion is converted into sulphuric acid instead of sulphurous anhydride. Now with the very large quantity of water which is specially formed during the oxidation of the sulphur a very much larger proportion of the sulphur gets converted into sulphuric acid than it does when the sulphur is burnt even in a damp atmosphere, and of course much more than when it is burnt dry. All this matter ascends, and is trapped, as it were, in that heated zone of air at the top of the room, which Dr. Odling so very well described yesterday, and we have up there an aqueous vapour so far removed from its point of condensation as to be what would practically be termed dry, and we have the vapour of this mixture of sulphurous and sulphuric acid. When the fire in a room goes out, and it cools down, this aqueous vapour condenses, and carries with it certain proportions of sulphuric acid varying with the quantity of sulphur which there is in the gas, and upon all the articles in the room where the moisture condenses (and the condensation naturally begins on metal work, which is colder) you have a quantity of very dilute sulphuric acid deposited. When the room is heated up again the water evaporates from that, and it becomes more concentrated, and you get a second dose the next day your gas is lighted, in the same way, and it gradually increases until, upon substances capable of containing moisture or of absorbing it—which is the case with leather and textile fabrics—you get a considerable amount of sulphuric acid concentrated in the material, and thereby increase the injury. We find, practically, that if you wash the surface of metal work which has been in an atmosphere where gas is burnt, you invariably get off a sulphate of the metal which you are using, whatever that metal may be. Moreover, if you wash out from textile fabrics the substance which they contain, you find a very considerable quantity of sulphuric acid in it.

Mr. O'HARA: Have you, since the maximum of sulphur was fixed, detected any benefit or any disadvantage to your own chemical instruments?

Witness: Certainly. I have no hesitation in saying that our delicate metallic instruments do not suffer in the City, now, as they did previously, or anything like those that I have at home do, where I get gas with about 25 grains of sulphur in it. I have been furnished with a valise by Jenner and Knewstubb, of St. James's Street, which has been on a shelf for about two years. I believe that there has not been a fire in the room, but there has been plenty of air. It was a well ventilated room, where they burn a good deal of gas in the winter time. Here is the leather which is outside, and which you will see has gone a good deal—it has been absolutely eaten away. Now in the interior, which of course has been subject to the same temperature as the outside, though not to the same influences, there is the leather as sound as possible. The outside and inside straps I have taken off for the purpose of experimenting with them, and they are not here; but the outside straps were corroded even more than the leather is; the inside straps were perfect. The outside straps, when boiled in water, yielded 2·4 grains of sulphuric acid, and each inside strap which was in a perfect state yielded 0·6.

Mr. O'HARA: To what do you attribute that 0·6.

Witness: I think it may have been that some air got inside from the room, or it may have been that a certain portion of sulphur might have been used in the dressing of the leather.

By the COMMITTEE: The 2·4 and 0·6 grains are the absolute quantity I got from each strap. The straps are the same length exactly, and they had every appearance of being cut off the same piece of leather. This valise has not been exposed in any way, in travelling or otherwise, from the time I got it. It is a piece of spoiled new goods, and has never been out of the shop. It only came to me the day before yesterday.

Mr. PHILBRICK: This is something that you bought recently?

Witness: I did not buy it, they furnished me with it; it has been on the shelf at Jenner and Knewstubb's shop, and I can bring the foreman here if you wish to see him. There is another point to which I should like to call the attention of the committee; which is, that the quantity of sulphuric acid which you are capable of condensing along with the moisture increases very rapidly with the increase of sulphur. When vapours are very much diluted they are much more difficult of condensation than when they are a little stronger, and I found, experimentally, that from the gas with which I am supplied at home—perhaps I had better describe exactly what I did. My gas is supplied by the West Kent Gas Company. They are under the 20 grain restriction; but it is not looked after, and practically I find that they give us from 21 to 25 grains of sulphur—that I have tried. Now, what I did was this—I lighted a 4-feet burner in a small room, a room containing about 290 feet of cubical contents. I burnt this 4-feet burner for two hours; consequently, of course, I used 8 feet of gas; and I then put into the room a flask filled with ice, for the purpose of condensing the moisture which the gas had formed in the room. I left that in for three or four hours more, so that from the time the experiment was started to the time it closed 20 feet of gas had been burnt, which would contain nearly 4 grains of sulphur. The room has a window which fits very badly, unfortunately. It is a room with a boarded side, and there is a considerable crack in the boards, so that there is by no means an absence of ventilation in it. I repeated this over three or four times, and by collecting the water which was condensed on the outside of the flask, I found that on a half-gallon flask I could collect in that water from a quarter to half a grain of sulphuric acid. I have repeated the same experiment in a similar small room, which I happen to have in the City, with gas which, at that time, contained about 8 grains of sulphur in 100 cubic feet; or, at all events, under 10 grains, and from that, proceeding precisely in the same way, I could collect as a maximum only 9-100ths of a grain of sulphuric acid; that I believe to be due to the much greater dilution preventing its condensation. But, out of those two experiments, the one was 9-100ths, and the other of the two was only 5-100ths of a grain, whereas in the first we got from a quarter to half a grain, where the quantity of sulphur was doubled.

Mr. O'HARA: What deductions do you draw from those experiments?

Witness: Certainly, that the sulphur ought to be kept down to as low a point as possible.

Examination continued: There are still some companies under the Act of 1860. One of them is the Phœnix, at Greenwich. As a rule they comply with the 20-grain condition. I have tested for it; and in complying with the condition they do not create a nuisance. I lived for upwards of 40 years very near them, and I never heard of one, nor have the authorities of Greenwich ever heard of one either. I scarcely know, of my own knowledge, any other companies in the country that have gas-works and keep a low average of sulphur without creating a nuisance. I know, of my own knowledge, that they do keep under 20 grains at Bath, and I am informed by the local authorities there that they have never heard of any nuisance, but beyond that I cannot go.

The CHAIRMAN: Do you happen to know whether in all those cases they use the lime process?

Witness: Yes; they do.

Mr. O'HARA: Is it your experience, or is it your view, that this lime process may be conducted without creating a nuisance?

Witness: I believe that it may, but not being a practical gas-maker I cannot go so far as I otherwise might; but I believe it may, because I believe that it is done. During the time that I lived in the Phœnix Gas Company's district, or part of the time, the sulphur was not kept very low, but lately it has been kept down very well indeed, until within the last week or two. They are now altering their plant, and have been obliged to

pull down some of their purifiers; and at the present moment it is, or was a few days ago, rather higher, but that is accidental. A part of the district supplied by the Phœnix Gas Company is within my supervision as gas examiner. Therefore, I am tolerably well acquainted with the capacity of the works, and the results of their operations.

Mr. O'Hara: Are you of opinion that the repealing of the penalty which is imposed upon a gas company—on this Crystal Palace Gas Company say—is a matter that you approve or disapprove?

Witness: I should certainly be very sorry to see it repealed altogether, taking the consumers view of the question.

Cross-examined by Mr. Philbrick: Prior to the Metropolis Gas Act, 1860, the Gas-Works Clauses Act of 1847 was the general law throughout the country, and there were then no restrictions as to sulphur compounds. The first restriction in the Metropolis was in 1860. My functions in the City only began under the Act of 1868. Before that, as a matter partly of scientific research, I had had experience in the subject.

Mr. Philbrick: Between 1860 and 1868—that is the time when London was under the Act of 1860—was there, to your knowledge, ever any proceeding or complaint of any one of the gas companies with regard to the sulphur compounds on the part of any of the authorities?

Witness: There was an attempt made by the City, which, I believe, at that time were the only authority who had an examiner, but it failed, owing to the lack of jurisdiction. It never was gone into on its merits at all. There were actual proceedings in two cases; one was the Chartered, and the other was the Great Central. I think it was only the Great Central for sulphur compounds.

Cross-examination continued: I think something was known of these sulphur compounds before 1856. We were acquainted with the fact of their existence long before that time, because when I was assistant to Dr. Leeson, as long ago as 1845, we were making experiments to ascertain their quality. That there was sulphur in coal gas in other forms than sulphuretted hydrogen was a matter of ordinary chemical knowledge that dates long before chemistry reached its advanced state as a science. Sulphuretted hydrogen at that time was taken out of the gas by means of lime, and until the discovery of hydrated peroxide of iron that was the only means of removing it. I am not aware, of my own knowledge, that there were ever any legal proceedings taken by private consumers in the City, under the Act of 1860, in reference to the sulphur compounds. There were, I believe, numerous complaints sent in to the Corporation as to damage done to goods, with requests that they would take action. The testings by the Referees are now made on an average of three days; they used to be taken for each day.

Mr. Philbrick: Is it not a matter of fact that two testings hardly ever agree, even by your own examiners and with the same gas?

Witness: Within very narrow limits.

Mr. Philbrick: But as a matter of fact, the same examiner, with the same test apparatus, dealing with the same gas, does not ever get to identically the same results?

Witness: I would not say never, but not always.

Do you remember a case where it has ever resulted that a gas examiner has got identically the same results—I will go so far as that?—I think I can remember a great many when we have had two apparatus working simultaneously side by side.

That is two instruments side by side; but I mean when the examiner has repeated the process with the same gas?—I do not exactly know how you could do that.

I do not mean where he is conducting two operations simultaneously; but where he has completed his tests, one after the other, with the same gas, supplied by the same company, is it not the fact that the tests do differ?—We cannot do that; we cannot get the same gas two days running from the same company.

I am talking of two hours running?—The sulphur test is a test extending over 24 hours, one test; so that we can never have the same gas two days running.

You know the test, as I understand; I mean in the testing process as directed in the Act of Parliament, and kept by the companies, and by which, by the provisions of the Act, the companies have agreed?—Yes.

Is it not a notorious fact that the tests made by the officers of the companies, in this matter of sulphur compounds, never correspond to the tests of the gas examiner, that there always is a discrepancy?—I am not prepared to admit that at all. They are frequently in accord, and very frequently not; but then it must be remembered that the gas companies test at the works, and we test a mile away from the works—1000 yards it is called, but it is practically nearly a mile.

The nearer the works so the greater ought to be the proportion of sulphur, ought it not—there would be a certain condensation through the pipes, possibly?—There might; or if the pipes were foul they might take up some.

But the tendency would be, would it not, if there was a difference between the two, to show the presence of a greater quantity near the works than at a distant place away from the works?—That might be so or not; it would depend upon the state in which the mains were.

As a matter of fact, the tests of the gas examiners are in excess, as a rule, of those of the company for sulphur, are they not?—I have heard it stated occasionally that they are; but I have also been told that they agree very fairly, taking it altogether, because the tests made by the companies testers I know nothing about officially at all—it is mere gossip with me what their testings are.

Cross-examination continued: The shop in which the portmanteau produced was kept for two years is supplied with gas by the Chartered Gas Company, who, as far as I know, have kept well within the sulphur maximum prescribed by the Referees. The straps which I removed were boiled in water in a glass vessel. A very large proportion of the sulphuric acid obtained by that process was in the form of free sulphuric acid, but I did not make any distinction between that which existed as one or the other. I only took the relative quantities in that which had been exposed and that which had not been exposed, and a highly acid solution came out.

Mr. Philbrick: Now, is not there always in leather the presence of some acid?

Witness: Of some acid; yes.

So that, therefore, you began your experiments with something that had got in it that which you were professing to want to find? You took a body that had got a constituent in it that you wanted to find—when you began to experiment with leather that was corroded you began to experiment with a thing which anybody, *à priori*, with a little chemical knowledge, could tell you had got the presence of acid in it?—Yes.

Then if you have the presence of acid and sulphur, or if you have sulphur in any form, you can always safely say that there is sulphuric acid in it, can you not?—Oh, no.

How can you tell what quantity there is? How can you tell that there is any free sulphuric acid?—The acidity is so much more marked than it would be from other acids that I think there is no question about it.

Then because the acid tasted a little sharper in the straps of the portmanteau, you therefore concluded that it was free sulphuric acid, and you put it down to the gas. Is that the chemical result which, as a gentleman of science, you are prepared to vouch here?—I do not feel any doubt about it at all.

Into questions of doubts in your mind, if you will pardon me, I will not enter before the committee; I want the question of chemical science, and fortunately I have the assistance of a gentleman who is able to keep me right?—In this particular instance I did not estimate the free sulphuric acid, but I have so often found free sulphuric acid under similar circumstances, about which I have not the slightest doubt, that I did not go into it in this particular instance. I merely took the comparative quantities of the two straps.

In giving the instance before the committee, I presume you were examined upon it, on the part of the Metropolitan Board, to bring about certain results. I will not go into any other cases than the one before us. Let me ask you, as a scientific man, how, as a chemical result, you can undertake to affirm that there was present in these straps free sulphuric acid?—I confess that I have made a slip upon that point on this particular occasion.

Mr. Philbrick: You shall pack up that slip in your portmanteau, and take it away.

Cross-examination continued: The experiment which I made in a little room at my house which contained 290 cubic feet of air, and in which I burnt the gas with a 4-feet burner, and condensed the vapour upon an ice vessel, was repeated by me in the City with the gas supplied by The Gaslight and Coke Company, who at the present time keep well within the restrictions of the Referees as to sulphur compounds. That room was rather less than the other. It was not without ventilation; it had no chimney, but was by no means hermetically sealed. The quantity of sulphuric acid I then obtained was very minute in any form.

Mr. Philbrick: Now it seems to me (I may be ignorant upon the matter) that if the West Kent Company were working down to about 20 or 25—your phrase is—and even to 30 grains of sulphur per 100 cubic feet, and the general result was half a grain, you ought to get from one-eighth to one-quarter if The Gaslight and Coke Company were working with half that quantity?

Witness: Not at all; but that is just the point that I want to bring out—that the sulphuric acid, however it may be in the vapour, is much more easily condensed when it exists in a larger quantity. Although the gas may really contain twice the sulphur, the condensed water will contain a great deal more of the acid produced by its combustion than twice the quantity, simply because, where the vapour is very diluted, it is much more difficult to condense; we have a number of instances of that.

I thought that condensation was dependent upon the temperature, and not upon the volume. What is the boiling-point of sulphuric acid?—I really forget—something between 300° and 400°.

Nearer 600°, is it not?—I suppose it is, but I really forget at this moment.

It is not between 300° and 400°, but nearer 600°. You say that it is more difficult to condense vapour that is in a more liquid form?—That is mixed with a very large quantity of other vapours, such as a very large quantity of the vapour of water, and a very large quantity of atmospheric air, and so on.

You mean to say it is difficult to condense the contents of a product, or difficult to condense the constituents of that product and separate it?—I mean that the same temperature would not produce the same amount of condensation relative to the contents.

If you say that there is a great difficulty in the condensation, is not that condensation the mode of test which the companies have for these sulphur compounds, and which they have to comply with under penalties?—That is by condensation in rather a different sense of the word; it is by condensation in condensing with alkali, and not attempting to condense it as it exists.

Have you, for the purposes of the experiments that you have been detailing to the committee, adopted a different mode of test to that which the Referees prescribe?—I was not simply testing the sulphur in the gas, but estimating the amount of sulphuric acid condensed on a cold article in a room in which gas had been burning.

And therefore arriving at the conclusion that whatever you condensed in the room on a cold surface, or a vessel filled with ice, must necessarily be due to the gas?—Not absolutely.

Cross-examination continued: I believe the Phœnix Company used lime exclusively for a very long time before oxide of iron was introduced. I left Greenwich in 1869. I do not know whether that was before the necessity for using lime again commenced. Gas is generally burnt in workshops, but I cannot answer the question whether it is rarely burnt in the dwellings of artisans in London. I regard the sulphur compounds as a nuisance which ought be eliminated as far as possible. Where gas-works exist in crowded places there is a difficulty in the removal of these compounds by means of lime; I do not say it is an insuperable difficulty. I said that, as a matter of observation, there is sulphuric acid found upon metal surfaces, varying in proportion to the sulphur compounds in the gas. What I mean is this, that, if you take metal-work which has been exposed to gas containing a great deal of sulphur, and that which has been exposed to gas containing very little sulphur, the same quantity being burnt in a room, you will find a great deal more of that metal converted into a sulphate in the one case than in the other. I believe this has been detected where 35 grains of sulphur compounds per 100 cubic feet have been present as against 15 grains. I think I could point to several cases in my own house. I have frequently washed off the sulphates of the metal from the surface of the metal-work. It must be sulphuric acid to make a sulphate of the metal. I refer principally to fine polished brasswork, and things of that sort; the brasswork of one's instruments, which do not have to be cleaned with preparations containing acid.

Mr. Philbrick: Seriously, are you meaning to represent to the committee that you can differentiate between what you wash off when you have been burning 30 grains of sulphur compound in 100 cubic feet of gas, and another quantity—a less quantity?

Witness: No, I do not mean to put it in that form; but I do say distinctly that I can, with the gas with which we were supplied in the City, freely expose delicate instruments in a way that I cannot do if I burn gas at home.

Re-examined by Mr. Cripps: I understood Mr. Philbrick to ask whether the quantity of acid bore any proportion to the quantity of sulphur existing in the gas, and I say that I find practically that it increases more rapidly than the increase of the quantity of sulphur. As an abstract proposition, I assent that it would be desirable to eliminate the sulphur compounds, if it is possible without creating a nuisance. Assuming it to be a nuisance, however, it is a nuisance limited in its operation to a certain number of persons resident in the neighbourhood of the works, whereas the benefit to be derived from taking it out of the gas is a benefit to the whole of the consumers.

Mr. Cripps referred to the examination of some of the witnesses before the Select Committee on the City and Metropolis Gas Bills in 1866-7 to show that complaints had been made, subsequent to the Act of 1860, of the impurity of the gas supplied in parts of the Metropolis. On his proposing to read a part of Dr. Letheby's examination,

Mr. PHILBRICK objected, and said: Dr. Letheby, we know, altered his mind before he died.

Mr. CRIPPS claimed his right to quote it, as the evidence on these Bills had been referred to this committee.

Re-examination continued: I have no doubt that sulphuric acid has helped very considerably to effect the corrosion of the leather of the valise I have shown here. I do not say there would have been no corrosion without it. I am not able to say that some other compound may not possibly have had to do in effecting it, but I know that sulphuric acid has been present, and has had its share in doing the mischief.

The CHAIRMAN: Besides the injury which you suppose is done to the brass and to the leather by this sulphuric acid in the gas, do you think it does any harm to human health or life?

Witness: I could not speak very positively—my own impression is that it does irritate the breathing organs and the eyes; but I could not say positively on that point.

In any appreciable degree, do you think?—I think so, but I would only give that as an individual opinion.

You do not know any instance in which you have traced, to your satisfaction, to that cause, irritation of the eyes?—I think I may say to the use of gas; but I would not say positively to the sulphur in the gas. I could not go to that length.

Mr. PHILBRICK: I may mention that Dr. Letheby, in the evidence that my learned friend has read, expressly said that it did not affect human health. He said that he could not say it affected human health.

Mr. CRIPPS: It is only fair that I should read this; he is asked whether these compounds are not pernicious, and then the question is put: "Because it forms sulphuric acid, or oil of vitriol, which destroys fabrics?—*A.* That is so; it quickly becomes sulphuric, it first forms sulphurous acid, and this, by taking more oxygen from the air, becomes sulphuric acid, or the acid sulphate of ammonia, which is very corrosive, and rapidly destroys fabrics; we have seen so much of that, that there can be no question about it, whatever theory may be formed of the nature of the compound, that is a destructive agent. *Chairman:* Destructive of what?—*A.* Of all kinds of textile fabrics, especially to paper, linen, leather, and also to brass-work. I know that unlacquered brass-work will not stand as it did formerly; it cannot be exposed for any time to air without undergoing corrosion. *Q.* And human health?—*A.* I do not think it affects human health much." That is the exact answer?

Witness: That is all. He does not say that it does not affect human health, but he says he does not think it affects it much.

The CHAIRMAN: Do you know what was the nature of the complaint on which the legal proceedings were taken by the City, which you mentioned against the gas company? What was it that they complained of exactly?

Witness: Their complaint was an excess of sulphur over the 20 grains allowed by the 1860 Act.

Mr. *Thomas William Keates*, examined by Mr. CRIPPS.

I am consulting chemist and superintending gas examiner for the Metropolitan Board of Works, and consulting chemist to the River Lea Conservancy Board, and have had very large experience. For some years past I have been very much engaged in investigations as to gas matters in the Metropolis, and was for two years also chemist to the City of London Gas Company.

Mr. CRIPPS: Let me direct your attention to the main point I want to ask you about. Of course, we assume that the only reason why this impurity should not be removed is the probable nuisances being created by the lime purification?

Witness: Yes.

Has your attention been specially directed to that question with a view of seeing whether that nuisance could be removed or mitigated—that is, the nuisance created at the works by the purification?—Yes, I have had opportunities of examining that question, and I have considered it very much, and I am of opinion that the nuisance has been greatly exaggerated and that the removal of sulphur could be effected to a moderate extent without creating any nuisance. It would, of course, mainly depend upon whether the lime, which has been used at the works for purification, could be removed without a nuisance.

First of all, what have you thought with reference to the possibility of disinfecting or mitigating the unpleasantness of the compound in the purifiers, which is made of the lime, for the purification of the gas?—I think that can undoubtedly be done. When the inquiry was going on before the Commissioners for the Board of Trade some years ago, I produced lime that had been disinfected in the purifiers, and that lime was completely inodorous; there was scarcely more smell in it than in a piece of chalk. And last year I had occasion to visit the works at Bromley. I was there with the late Dr. Letheby, when one of the large purifiers was opened. I then took a quantity of lime from the different shelves of the purifiers, and examined that lime, and found that it was quite disinfected. The noxious material in the foul lime has been already stated to be sulphide of calcium, which is an active principle used in taking out these sulphur compounds. That sulphide of calcium is a very foul, stinking material, and on this occasion I found that it was almost entirely removed from the lime.

Mr. PHILBRICK: I do not like to object to my learned friend's line of examination of Mr. Keates; but I must remind the committee that the allegations which are made on the part of the Metropolitan Board are not that any nuisance that is now existing, or might exist, from the impurity of these articles, can be removed or mitigated; but that the allowing of the presence of these sulphur compounds in gas would be very prejudicial to the sanitary condition of the district.

Mr. CRIPPS: Then that raises the whole question. The answer to that is that it cannot be done because it creates a nuisance, and the rejoinder to that is that it can be done without creating a nuisance.

Mr. PHILBRICK: I will not press my objection.

Mr. CRIPPS (to witness): Will you go on with what you were saying?

Witness: I was stating that the lime removed from the purifiers was completely disinfected, and I understood that that process was in current use. It had been first rendered foul, so as to make it capable of taking out the sulphur compounds. I think there are three different methods by which it can be done—one is by passing air through the foul purifier; another by continuing to pass crude gas through until the lime is converted into carbonate of lime; and it can be done by passing the products of gases from a furnace through the purifier—that was an invention which I think was used by Mr. Mann at the City of London works, and was patented by him—*i.e.*, passing the heated gases from a burning furnace through the purifier so as to use the carbonic acid which was produced by the combustion for decomposing the sulphide of calcium and producing carbonate of lime. As far back as 1859, I think, during an inquiry in connexion with a Bill promoted by the City of London Company for a new charter, strong evidence was given by many scientific witnesses upon the point that lime can be converted into carbonate without difficulty, and can then be removed without being at all a noxious thing.

Assuming that it were possible in either of those ways to do it, that probably might involve increased expense?—I do not know, but I think the companies are mostly prepared to do that at the present time. I know that it has been put forward as a plea that in some cases the companies were making alterations in their purifying plant, and when those alterations were completed, they would be able to carry on those processes.

But setting aside any question of expense, of course you will probably say that, if it can be done, the consumers are entitled to insist upon it?—I speak of the thing as a chemical fact more than as a question of anything else.

Now, if that were done, would the lime when it came out of the purifiers be free from that noxious smell which it has at the present time?—Comparatively free. No materials in a gas-works can ever be turned out quite free from smell; they all carry with them their characteristic odour of gas, and so far as I am aware nothing will remove it entirely. That applies to everything. Oxide of iron, which I believe is supposed to be a perfectly innocuous thing when it gets out of the purifiers, has that peculiar gas smell which cannot be got rid of so far as I know.

Probably it could only be mitigated, at least in the gas-works, being in in a part where the population is not very thick, and removed as far as it can be?—I suppose that is the only entire remedy for it.

That is a matter that has been going on from year to year for some time past?—Yes, now some of the larger gas-works are removed from London. The largest gas-works, the Beckton Gas-Works, are some miles down the river; the Bromley works have also been removed from the neighbourhood of houses.

What you suggest would remove the special difficulty supposed to be created by lime purification?—Yes, the lime purification *quoad* this particular question.

Would it at all prevent the lime being used, as it is used now, for taking out the sulphur compounds ultimately?—The sulphur compounds are taken out by lime, the sulphuretted hydrogen is taken out by oxide of iron, and to that extent it would remain as it is; the oxide of iron would still be used partially.

Cross-examined by Mr. PHILBRICK: It is necessary to use the lime in the second set of purifiers, if you adopt Mr. Patterson's mode, in an exceedingly foul state, so as to absorb these other sulphur compounds. I know that passing air through the purifiers has been tried at Bromley, and that the actual effect of doing it was to produce an explosion; but will you allow me to explain? I am told that that has happened, and I can easily believe it is so, but it does not follow at all that that system might not be improved so as to avoid this difficulty. I may say that when I was at Bromley, on the occasion that I mentioned before, they were passing air through one of the large purifiers then; they had been passing crude gas through the purifiers for a considerable time, until they had converted all the lower layers into carbonate of lime from the carbonic acid in the crude gas. Then they had reversed the process and had passed air downwards, and by that means they had converted the upper layers of lime chiefly into sulphate of lime, and there the process was going on, and I did not understand that there had been any difficulty about it.

Mr. PHILBRICK: Did you hear of the fact that the trays had been set on fire?

Witness: I admit that may be the case; when rapid oxidation goes on, you are subject to that sort of thing, but I do not admit that it cannot be remedied.

At the present moment Bromley is the only place where that system of driving the air through the trays of the purifiers has been attempted?—There was some system of the kind, I cannot tell what exactly, in operation at Fulham some time ago. I know that Fulham has always been bitterly complained of; but it does not follow that the cause of the complaints might not be remedied. I had occasion to go to Fulham some two or three years ago in consequence of a nuisance. I was instructed by the Board to go and see the works, and I went and I found that that complaint did exist, but I was told in the works that it would be very soon remedied. I made a report upon it at the time. The second mode I mentioned was passing crude gas through. That is the method by which this foul gas is made in doing that to extract the sulphur compounds. I do not know that it is practised to the extent of going so far as I am saying. It can be done without difficulty, and it was done in the case that I spoke of in one of the purifiers at the Imperial works, and there the change was most effectual, and I found 90 per cent. of carbonate of lime. The effect of that is to carry the sulphur on in the gas necessarily, but then you see, according to this system of purifying gas from the sulphur compounds, it is a necessity, and the passing on of this sulphur becomes a useful thing, and not a detrimental thing, because it can be employed in converting fresh portions of lime into foul sulphide, which will afterwards act upon the sulphur compounds. In a sense the effect of it is to postpone, in one stage of the process, the purification.

Now the third one, in which you drove heated air from the furnace through the purifiers, is a process which has never been carried into effect at all?—I do not think it has, but it was advocated by one of the most practical engineers of the day—Mr. Mann, of the City of London works. He never carried it into execution himself, and nobody else has adopted it.

Did you test for these other sulphur compounds on the part of the gas company as against Dr. Letheby when he was testing on the part of the City?—I did.

As a matter of fact, let me ask you, in testing for them with this operation of nicety, did your tests practically agree? Was not there considerable discrepancy?—I do not think there was. There were occasional discrepancies, and very large discrepancies; then the thing was brought to a test on a particular occasion. There were continued disputes, I may say, between the company and the corporation at that time. On one occasion I went to the London Hospital, and Dr. Letheby went to the works; Mr. Warrington, of the Apothecaries Hall, went to my laboratory in Blackfriars, which was at that time the last place on the gas-mains. I may say it was in reference to the Great Central Gas Company that these disputes were arising, and then, by-the-by, I was testing for them, and not for the City of London Company; but on this occasion, some five or six of us made a similar experiment at seven o'clock in the evening, and we got exceedingly coincident results.

You got coincident results; but prior to that time when you had been testing, or assuming to test, the same gas, were there coincident results?—I tested the gas of the City of London Company for several years, and there were occasionally very great discrepancies between myself and Dr. Letheby.

Do those discrepancies arise from errors on the part of the observer, or from that which is inherent in the mode of testing?—You ask me a question that I cannot possibly answer. With regard to the errors on the part of the observer, I cannot tell you about that; I can only tell you that I think I was right. It is not a delicate operation to test for these other sulphur compounds. It is an operation that is carried on in some places in London every night. I am willing to admit that you never get exact concurrence, but you get it so close that you may take the result as being practically true.

Now just as to this matter—as to the presence of these sulphur compounds in the gas—supposing there to be, I will assume, 20 grains, which is the limit—in order to get 20 grains you have to work to a minimum—you have not much less than that in practical gas-making?—I suppose you have to have a margin of safety.

Practically you require 20 grains, in order that the gas-maker may be

safe, he has to work down to 15?—He would have necessarily to work to something less.

Now take the gas which would be supplied under a restriction of 20, and which would be 15 or 16, or whatever it might be; and take a gas which had 30 or 35 grains of those other sulphur compounds in it per 100 cubic feet. Do you say, as a gentleman of experience, that practically to a consumer burning that gas there would be any real difficulty or difference?—I am myself rather in favour of relaxing the limit. I think that a little above 20 grains may be allowed, but I think that it would be the greatest possible mistake to remove the restrictions altogether.

How much would you give, then?—I think even 25 or 30 grains might be allowed, but I think that there ought to be a strict limit put upon it.

With regard to the limit, that is a matter of policy and discretion, but with regard to the 30 grains, you would say, as I understood you, this—that if the process of purification by lime can be conducted, if proper appliances be used, without creating a nuisance, you still say it is not weighing one nuisance against the other, but you say you would not object to even 30 grains of sulphur in 100 cubic feet of gas, in the interests of the consumer?—I think it would be straining the thing in favour of the company; but when you consider the expediency between a nuisance created and an advantage to be gained, I think that 30 grains may be allowed.

You say that would practically bring it down to 25?—That is the way you put it; but I do not think it is so really.

In order to get at the limit of 20, you will have to use quite as much lime as if your limit were 30, would you not?—I think certainly not.

You would have to put not quite so much lime, but you would have to have as large a surface of lime at a time employed?—Even supposing that was so, that would make a great deal of difference in practical gas-making in the works.

Cross-examination continued: I have said, in a letter which has been published, "It will be seen that the talk which is made about the sulphur in the gas is, after all, practically a thing of very little, if of any consequence from a sanitary or economical point of view." My opinion is not in the least changed as far as all that goes. Bisulphide of carbon has been actually burnt in a lamp specially contrived by me, and used for disinfecting and antiseptic purposes. The bisulphide of carbon is a compound of sulphur which in burning gives off an enormous quantity of sulphurous acid. Some time last year a paper of mine was published in the *Lancet*, recommending the use of bisulphide of carbon to be used for disinfecting purposes; but if you put a lamp here, containing bisulphide of carbon, which is a liquid like spirits of wine, it would be impossible for you to stop here after a minute or two. It is the same thing that you get when you burn sulphur. If you burn a quantity of sulphur, you very soon bring the atmosphere into a state in which you cannot breathe, and that is just what happens when you burn bisulphide of carbon.

Re-examined by Mr. CRIPPS: Bisulphide of carbon may be very useful as a disinfecting agent, but extremely disagreeable. There is no comparison between the things—not the slightest; if you light a brimstone match, and hold it to your nose, you will, in fact, be getting sulphurous acid. The testing under the Act of Parliament for sulphur compounds is not one testing only, but since last year the average testing of a day. In the case of a penalty the average of three days must be taken.

Mr. CRIPPS: That is with regard to the Chartered Bill, is it not?

Witness: Yes; I was thinking of the law in the Metropolis. I do not know how that is in the Crystal Palace Act.

Mr. PHILBRICK: It is a simple testing in our Act.

Mr. CRIPPS: If it is so, I am wrong.

Mr. PHILBRICK: In our case it is a single test on a single day, one test on one day, and we have had to pay the penalty.

Witness: It does not say anything about the average of any number of testings. It cannot be otherwise, because the testing for sulphur occupies the day; therefore there cannot be any average of testing, the test is going on during the whole day—it is continuous. It is continued for about 20 hours—the gas must burn that time.

Mr. CRIPPS: You say very properly that for the purpose of avoiding a penalty, the care to be taken at the works would always go somewhat beyond the exact amount of the penalty?

Witness: It must do so just exactly in the same way gas companies are obliged to give something above the illuminating power in order to secure the minimum.

Whatever that amount may be does not matter exactly. Now with reference to what I asked you in chief, and what my learned friend has been upon, about those three modes of purifying by lime, which is an important point. He puts it to you that by passing in the air, on some particular occasion, an explosion was produced. I understood you to say that that explosion is not a necessary effect of what you suggest should be done?—The explosion, I take it, happened in this way. The air passing into the purifiers expelled the sulphuretted hydrogen, which is a combustible gas, and when sulphuretted hydrogen is mixed with a certain quantity of atmospheric air it becomes an explosive compound; and what happened, I take it, was this, that, as the lime was passed into the retort, it discharged the sulphuretted hydrogen, and this, being mixed with the air, went into the furnace, and an explosive mixture necessarily was formed, and it exploded. I do not know, but I should think, as an engineering question, that that difficulty might be got over in this way, that these gases might be passed through a sort of supplemental oxide of iron purifier which would take out the sulphuretted hydrogen at once; and, therefore, it would not be necessary to burn it at all. The accidental occurrence of that explosion does not alter my opinion about the feasibility or practicability of the thing.

Mr. PHILBRICK: It was the air going through the oxide in this case, I am told.

Witness: Of course, I do not know; but I do not see what the air going through the oxide could have had to do with the defœcation of the lime purifier; it does not relate to these matters at all.

Mr. CRIPPS: You consider that that could be done?

Witness: I think that it could be; it appears to me the only difficulty is an engineering difficulty, which might easily be got over.

Then, again, with reference to putting gas through, it is put to you that that would postpone the process of purification—would that signify at all?—No; I think it is very much a question of space; I suppose that is one of the great difficulties that gas companies, particularly London companies, have been always placed in; the want of space for extending their purifying plant; but that certainly would not apply to companies outside, where they have abundant space.

The CHAIRMAN: Do I understand your evidence to be that you hold that the difference between 20 and 30 grains of these sulphurous compounds does not make any substantial difference to the injury done to leather, metals, and so on?

Witness: Of course, whatever difference it would make, the effect of sulphur is, no doubt, in exact proportion to its quantity; therefore 20 grains produce a certain quantity of sulphurous matter in the atmosphere; 30 grains would produce one-half more; and, therefore, whatever the effect of 20 grains would be, the effect of 30 grains would certainly be greater in that way.

Do you agree that the presence of this sulphurous matter in the gas which we burn has to any extent an injurious effect upon pieces of leather?—I think that question has been very much exaggerated. There is no doubt at all about the fact that you actually find sulphuric acid in things that have been long exposed to the action of gas. I have taken down for the purpose of experiment, within the last few days, a line which has held up a picture for a great many years in a room. I thought it was fairer to examine that than it would be to examine leather, which is sometimes treated with materials containing sulphuric acid in some form. I have examined this line, and I find it does contain sulphuric acid in a small quantity; it contains sulphuric acid in the free state—some portion of it is neutralized, and some portion of it is in a free state, but you can obtain from this piece of material, without the slightest difficulty, indications of sulphuric acid. That piece of line had been up for a long time. I cannot remember in the least when it was put up, but I should think it must have been up 20 years; it has been hanging in a room in my house, and I thought that that was a good material to experiment upon.

Might I ask you, with regard to the sulphurous compound or sulphuric acid, do you believe that the presence of the sulphurous ingredients in the gas is injurious to human health or life?—No, I do not, in the small quantity in which they exist.

Do you believe that the other one—the nuisance of the sulphide of calcium produced by the lime process—is injurious to health or life?—No; I do not think it is. It is a foul thing, and it is a very offensive thing; but I never have known cases of damage to health that could at all be attributed to the effect of gas-works. I think rather the reverse is the case. In inquiries that have taken place, I think it has always been shown that gas-works are ordinarily healthy places.

Mr. PHILBRICK (through the committee): Will you tell us whether in that room where the line was, there was gas burning, or only a coal fire?

Witness: There were both; it was a little library, which is lighted every night with gas in my house at Dulwich.

Dr. *Edward Frankland*, examined by Mr. O'HARA.

I am a Professor of Chemistry in the Government School of Mines, and also a Doctor of Philosophy, a Doctor of Common Law, and a Fellow of the Royal Society. During the greater part of a quarter of a century I have frequently been called upon to make investigations connected with the manufacture of coal gas, and I have had many opportunities of inspecting gas-works, and have seen the processes carried on there. Besides sulphuretted hydrogen, crude coal gas contains bisulphide of carbon, or bisulphuret of carbon, as it is frequently termed. The other compounds contain both sulphur, carbon, and hydrogen, and all those compounds when burnt alone yield practically the same products of combustion—that is, chiefly sulphuric acid and partly sulphurous acid. Until about the year 1856 the purification of gas was effected by means of lime. I think that was about the time that the change took place. The purification by lime removes not only the whole of the sulphuretted hydrogen present, but also a large portion of the other sulphur compounds—the bisulphide of carbon and the sulphur organic compounds as they are called; whilst peroxide of iron removes only sulphuretted hydrogen. My experience would lead me to say that, under the lime process, the number of grains of sulphur in 100 cubic feet of gas would, on the average, rarely exceed 15. I mean to say that the quantity of bisulphide of carbon and other sulphur compounds, other than sulphuretted hydrogen, will not contain more than 15 grains of sulphur to the 100 cubic feet of gas after purification by lime. The peroxide of iron system leaves a quantity varying from about 28 or 30 grains to 40 grains of sulphur per 100 cubic feet. Perhaps I ought, in completion of the answer to your former question, to add that the proportion of those sulphur compounds in gas depends very much upon the way in which the gas is manufactured. If the gas is manufactured at a very high temperature, by which a large quantity of gas is produced of a lower illuminating power, there is always much more of those sulphur compounds than are present when the gas is subjected to a lower temperature, so that it will necessarily vary in different gas-works. During the combustion of coal gas a considerable portion of the sulphur is converted into sulphuric acid and the remainder into sulphurous acid, but this sulphurous acid, diffusing itself through the atmosphere of the room, passes very quickly into sulphuric acid, and I should say that for all practical purposes it may be held that in a room in which gas is burnt freely in the open air of the room, all the sulphur passes into the state of combination known by chemists as sulphuric acid, or oil of vitriol; and 100 cubic feet of gas containing 40 grains of sulphur would produce, when burnt, rather better than 122 grains of oil of vitriol.

Mr. O'HARA: Now, what becomes of the oil of vitriol?

Witness: As oil of vitriol cannot exist as a gas at the ordinary temperature of a room, it condenses to minute drops—to the very minute kind of drop that you have in a fog—and floats about in the room until it is either removed by ventilation or attaches itself to some object in the room. Those minute drops are too small to be seen by the naked eye, except under favourable circumstances. You can see them if you pass a ray of sunlight through the room, or a ray of electric light; you can see that the air is filled with minute drops of something; but then, as there are so many minute drops of other kinds of liquid, I do not mean to say that you can see the sulphuric acid drops amongst the others. These drops attach themselves to walls, furniture, decorations, and so on. They destroy books, and corrode gilding and paperhangings, and so on. They perform all those reactions which are well known to follow the application of sulphuric acid. I may mention, as a matter of my own experience, within my own house, during the last few years, that I have found the bell cranks to be very powerfully corroded in the butler's pantry, where those bell cranks are placed near the ceiling, and therefrom get rather a large dose of the sulphuric acid so produced by the gas. Those bell cranks, being corroded, stick fast from time to time, and on examination I find that they are covered with the crystals of sulphate of copper. Of course, sulphate of copper, I need not say, is the product of the action of sulphuric acid and air upon copper.

In the total estimate of the damage to goods, can you give us any ratio of the proportion of damage by gas?—No, I cannot.

Mr. PHILBRICK: A compensation case?

Witness: The damage caused is not merely proportional to the quantity of sulphur in the gas, but I should say it would be likely to increase at a more rapid rate than the increase in the proportion of sulphur in the gas; but that is a matter of opinion.

Mr. O'HARA: Have you anything to say about the comparative results of burning gas in Liverpool, Manchester, Edinburgh, Glasgow, and London with reference to this sulphur?

Witness: I think that the illuminating power of the gas that is burnt is a very important factor in the case, because, if for the production of a given quantity of light you require to have a large volume of gas, you will get more sulphuric acid produced in your room than if you are burning gas of a higher illuminating power; and, as the gas with which we are supplied in London possesses very low illuminating power as compared to what is supplied to many other towns in the kingdom, I think that is a very important element in the matter, and that it is desirable that the

sulphur should be kept down in the London gas to the lowest practicable amount.

In your opinion, as to the use of lime for the purification of gas, if it is attended with proper precautions, should it cause a nuisance in the neighbourhood?—It certainly would not with proper precautions. I have known the process carried out in Manchester, where I lived for six years, and had an opportunity of seeing this process of purification by lime carried out. There was practically no nuisance to be complained of at the gas-works, but there was a nuisance by carting this lime through the streets. It was originally carted away in open carts, and, of course, the lime smelt abominably as it passed through the streets. That was really an unnecessary thing, as it could have been taken in closed carts, and then, of course, there would have been no nuisance of that kind. It was not in consequence of the process at all, it was the careless way of doing it.

Supposing for a moment that it was necessary to devise another process, can you state to the committee how, while still using peroxide of iron, the sulphur might be removed from the gas in a different, and, perhaps, in a more satisfactory manner?—There are several processes which have been proposed from time to time, and one of them, at least, has come into practical use, I believe; but I am not able to speak, from my own observation, as to its success. One of those methods, and the oldest of them, is that known as Bowditch's process, which consists in passing the gas over heated lime, lime heated to about 500° Fahr., and maintained at that temperature. The sulphur compounds which I have been speaking of are, by contact with this hot lime, transformed into sulphuretted hydrogen, which can be then removed by passing over peroxide of iron, and getting rid of sulphuretted hydrogen, that is clear. I mention this method as a process that could be used if it were again found desirable to substitute the peroxide of iron for the lime purification, because then the peroxide of iron would remove the sulphuretted hydrogen caused by the heated lime. The heated lime goes on performing this function for a very long time, it is very long before it gets exhausted, so that there is practically no expense in the lime; the only cost consists in the provision of the plant, and in the maintenance of the lime and gas at the temperature of 500° whilst the action is going on. The quantity of lime is infinitesimal here.

Then, with reference to the plant, you said it was simple plant?—I think so; but I am not an engineer, and I have not seen it erected on a large scale, so that I would rather not say anything about it. That is one of the processes. I said there were three of them. The second process is the invention of Mr. Vernon Harcourt, who substitutes porous materials of various kinds for the lime, and finds that they will, to a certain extent, at least, perform the functions of lime. I have no experience of that process, and have only heard that it can be used in that way.

The substitution of porous substances, such as brickbats, and so on, for lime?—Yes. Then there is a third process, which, I believe, has been extensively used in the Manchester Gas-Works, and that is Mr. Leigh's process of removing sulphur compounds. It consists in washing the gas with sulphuret of ammonium—with the gas liquor, in fact. By bringing the gas in contact with the gas liquor that is collected in the condenser, those sulphur compounds are extracted from it to a considerable extent, and the sulphur is brought down to 10 or 15 grains, or something like that. There is another process, I believe, by General Scott, which is a modification of the lime process. It is by heating the lime in a different way. It was tried, I may mention, at the South Kensington Museum a year or two ago on a tolerable scale, and was found to answer pretty well.

Dr. Odling was called here yesterday, and he gave the committee some very interesting evidence, and admitted, if I take his evidence correctly, that there was damage from sulphur, but he said it was due to desiccation of air, and not to the sulphur from the gas. Did you hear him say so?—No, I was not here yesterday at all, and I have not had an opportunity of reading the evidence.

Dr. Stevenson put in evidence two tables showing results in two rooms, in one of which gas was burnt and the other oil, and I find that practically the desiccation was the same in both cases. The desiccation, therefore, being common to both, we must ascribe the damage which took place in the one and not in the other to the sulphur which was in the gas?—Dr. Stevenson's results show that which I certainly should anticipate would be the case, because in burning oil in oil lamps you produce a much smaller quantity of water for a given amount of light than you do in burning gas; consequently, I should think that the desiccation would be, perhaps, a little greater in the case of oil lamps than in the case of gas. It certainly would be very much greater if you require to develop the same quality of light. But then an oil lamp produces less heat per 100 units of light than a gas lamp; therefore I should anticipate the desiccation would be something nearly the same with oil as with gas, and that is what Dr. Stevenson appears to have got as the result of his experiments. My own experience goes to show that you may burn oil lamps in rooms without any damage of the kind complained of, whereas you cannot burn gas. Bisulphide of carbon, when burnt alone, becomes chiefly sulphurous acid—almost entirely sulphurous acid—and that simply in a room gets converted into sulphuric acid. But the conversion into sulphuric acid is very much facilitated by a moist atmosphere; but a good deal of the matter in the atmosphere, which is supplied by the gas, the water, and the sulphide of carbon, is burnt in the gas. When burnt in the gas it becomes almost entirely sulphuric acid before it leaves the room, unless the ventilation is very good indeed. I think that is a very objectionable thing.

Mr. Philbrick (in cross-examination): You have given us three lime processes, or three processes of purification; I will ask you a question or two about those. First, as to Mr. Bowditch. Do you know that the Bowditch process was put into operation at Wakefield?

Witness: I am not aware that it was put into operation on a large scale. I know that Mr. Bowditch made experiments on what would be the largest scale experimentally there, but I am not aware that it was ever applied to the whole of the Wakefield gas.

Do you know from your own knowledge, not from hearing or from what others have told you, that the Bowditch process has ever been practically used?—I do not know from my own knowledge that it has been practically used on a large scale. I have used it myself for months on a small scale.

Do you know that it was tried at Wakefield, and that it was found impracticable to subject the gas to the heated lime a sufficiently long time to satisfy the exigency of gas-making in a practical way—that that was the objection?—I do not know it, because, as I say, I do not know anything about Wakefield.

Cross-examination continued: I believe that Mr. Vernon Harcourt's process of heating the gas has been put into operation to about the same extent as Mr. Bowditch's; but I may say, with regard to that process, that I know nothing of my own experience; I have not even tried it myself. I know that he invented it, and I have heard him say (and he is a great authority in gas matters) that he has no doubt it could be practically applied. Mr. Leigh is the Medical Officer of Health and Chemist to the Manchester Corporation. The corporation are the owners of the gas-works in that city. I believe they have adopted Mr. Leigh's process; I have not seen it, but I have been told that they have applied the process for several years past; it is not a newly-invented process. I do not know that they abandoned it in 1875, and have not used it since. I remember hearing of its being tried in the South Metropolitan district. I do not know that it proved an utter failure. General Scott's process is lime heated at a higher temperature, and some other modification also. It has not been adopted, except experimentally, at the South Kensington Museum. My opinion is that all the sulphur compounds which are burnt in gas ultimately resolve themselves into sulphuric acid. I presume we may say that the whole quantity at the point of combustion is, for the moment, in the condition of sulphurous acid. I have made experiments—not in a room, but in a glass vessel—to determine the relative proportions of sulphurous acid and sulphuric acid in the combustion of ordinary gas. There are no known methods by which the relative quantity of sulphurous acid and sulphuric acid can be determined at the very moment in a room with accuracy, but in their passage to the room you can determine. I do not think I have ever determined the presence of sulphuric acid in a room.

Mr Philbrick: Not having determined it to be present, why do you say it ultimately assumes the form of sulphuric acid?

Witness: I will tell you exactly. I have received the product of combustion from an ordinary gas-flame in a class cylinder of a particular size, and I have determined the quantity of sulphuric acid and the quantity of sulphurous acid produced under those circumstances, and I have found a certain quantity of sulphurous acid there and a certain quantity of sulphuric acid. Then I have increased the size of the cylinder and repeated the experiment again with the increased size of the cylinder, and there was always a large quantity of sulphuric acid and a smaller quantity of sulphurous acid formed, and as the result of these experiments I concluded that when those products of the combustion of gas are passed into a room instead of into a small glass cylinder, then all the sulphurous acid is converted into sulphuric acid.

First let me ask you, was it a closed cylinder?—No, there was a draught to it, by which the products of combustion passed through the cylinder. There was first a trumpet-shaped tube over the gas-flame, by which the products were conducted into the cylinder, and another tube from the cylinder, by which the unconsumed products escaped into the room.

Was that what is known as the Letheby apparatus?—It was substantially the same as the Letheby apparatus.

Did you find there the sulphuric acid combined or in a free state?—In the free state almost, in the largest cylinder; all the sulphur compounds I found in the water condensing there were in the condition of sulphuric acid; there was not a trace of sulphurous acid.

But the large cylinders were abandoned, were they not, because they were found not to absorb one fifth of the entire quantity?—Certainly not; they absorbed a great deal more than that.

Were they abandoned?—The Letheby process of determining the sulphur and gas was abandoned in favour of the more accurate process invented by the Gas Referees.

Under Dr. Letheby's own advice and opinion, in carrying out his own experiments, was not the large cylinder abandoned in favour of the smaller one, because the smaller one was more accurate?—No; certainly not. In my experience the larger the cylinder the greater the amount of sulphur that is to be obtained in the shape of sulphuric acid from burning gas.

I am quite aware that you have said that the larger the cylinder the more often these products shape themselves into sulphuric acid. You have used that as an argument to show that in a room there would be a still greater proportion of sulphuric acid?—Yes.

Do not you know that Dr. Letheby himself, in conducting his own experiments in his own way, he being the discoverer of these sulphur compounds, actually prohibited the use of these large cylinders because they led to results that could not be trusted?—If he did abandon them it would be because they gave too much sulphur.

You do not mean to say that a man like Dr. Letheby, who has passed away from us—a gentleman of his scientific attainments—would discard an apparatus because it led to a certain result, if he believed that result to be a true one?—First of all, I do not know that he did abandon the large cylinders; and, in the second place, I know that if he did it is quite contrary to my experience that they ought to be abandoned because they give too little sulphur, because I always found the larger the cylinder the more sulphur you obtained in the shape of sulphuric acid. Just allow me to explain that part of my answer to which you seem to take objection. Dr. Letheby, in proposing this method of testing gas, had in view the use of a particular sized cylinder, and he said, "That is my apparatus, which has such and such dimensions. The gas ought not to contain more than 20 grains of sulphur in 100 cubic feet." Then it was found afterwards, I think by other persons, not by Dr. Letheby, that the larger cylinder produced more sulphuric acid; but Dr. Letheby, I think, altered his evidence before the committee, and said, "It is not fair to use the larger cylinder; the Act of Parliament contemplated the cylinder of the size in which I first invented it;" and that was the reason, I believe, that he abandoned it.

If you have exactly represented the effect of Dr. Letheby's evidence in the reverse sense to that in which he gave it, what would you say about your conclusion?—I cannot alter my conclusion from my own experience.

Then it strikes me that your conclusion is entirely independent of the premises from which you draw it?—No; it is based entirely upon my own experiments, and I cannot give up my own experiments.

Is the free sulphuric acid, which you say you found in these tubes, produced always under the same conditions as they would be by the burning of ordinary gas in an ordinary apartment?—It is as near as possible, in the experiments to which I have referred. The difference is simply that the products are passed into a smaller chamber instead of a large chamber. There was no ammonia put in the chamber. These were experiments with a view of ascertaining how much free acid there was, and there was a considerable quantity—a large proportion.

Cross-examination continued: There is no sulphur test in Manchester. The gas there is of a higher illuminating power than in London. I am not aware that in Manchester the injurious effects attributed to the sulphur compounds are visible all over the city. The quantity of sulphur given off there is reduced to about one-half, by the gas being of double the illuminating power, with the ordinary burners employed. At Manchester I believe they do not use lime, but peroxide of iron in the purification. It is cannel gas supplied there which cannot profitably be burnt in an Argand burner. It is better to employ a fishtail burner. Cannel coal does not contain a greater proportion of sulphur, as a rule, than ordinary coal; at all events, what is really of importance here is this, that the gas manufactured from cannel coal contains less of these objectionable sulphur compounds than gas from ordinary coal, because it comes off at a lower temperature. I do not know, since the tests have been taken in London, that at the stations where cannel gas is made the proportion of sulphur compounds has been invariably greater. I have not seen any room in Manchester where injury has arisen from the sulphuric acid produced by the combustion of gas. I have not lived in Manchester since 1857, and at that time they were purifying with lime. I have seen its corrosive action in my own rooms in London, first at Haverstock Hill, between 1857 and 1860, and then at Lancaster Gate up to the present time. In both cases the gas was supplied by the Imperial Company. I have not

noticed the effects in the formation of a zone round the top of the room, but I certainly noticed that these effects were very much stronger nearer the ceiling. The metal articles about the room, or 3 or 4 feet from the floor, were comparatively unacted upon, while any metallic substances near the ceiling were rapidly corroded. I never made any experiments as to where the action began. They were really not experiments, only the result of experience. I found that the brass cranks at Lancaster Gate, from 6 to 12 inches from the ceiling, were very powerfully corroded, and covered with crystals of copper. I cannot tell what wash they had been dipped in by the manufacturer; but whatever it was it had all gone, while the other cranks retained their wash. This was in the pantry—a small room where the ventilation was deficient. I never burn gas in the ordinary rooms of the house; I have given it up now on account of the sulphur compounds and the low illuminating power. It is only burnt in the basement and in the passages now. There are no damp walls in my pantry, and a damp wall would not produce sulphate of copper. I use paraffin duplex lamps in my dwelling-rooms. There is scarcely a trace of sulphur in paraffin.

Re-examined by Mr. CRIPPS: The quantity of cannel used in making gas in London is only a small per centage; but in Manchester the gas is made entirely of Wigan cannel. If you have a gas of high illuminating power, you do not want so much of it in quantity; and I know from my gas bills that I used much less in Manchester to illuminate my rooms than I did when I used gas in London. I should, therefore, not expect to find so much sulphur compound present.

Mr. CRIPPS: I want to ask you about the inverted tubes that you have spoken of. You say where the tube is contracted the sulphurous acid is generally found, but when you get the larger tube you find sulphuric acid?

Witness: Yes, I found sulphuric acid myself in the very smallest tube, but more in proportion to the size of the chamber—it is not exactly a tube.

If, instead of being a chamber, it was a room, there would be a considerable portion of sulphuric acid there, would there not?—I think that is a fair inference.

Will you tell the committee why that is—you, of course, have a reason to assign why, as the tube widens, the sulphuric acid increases?—The transformation of sulphurous acid into sulphuric acid is a question of time, and the length of time you could allow these products to remain in a close chamber, even of the largest size that can be blown, is, of course, very small, compared to the length of time it would remain in a room; hence the process of transformation will be much more perfect in the room itself than it possibly could be in the largest glass tube that could be used for the experiment.

By the COMMITTEE: It would take a longer time to deposit, and to combine with oxygen it must combine with atmospheric oxygen; that is a process that requires time—say ten minutes or a quarter of an hour—and you must keep up a rapid current of air over the glass to get perfect combustion, and all this air must be carried up in a glass chamber in order to deposit the acid. I should not say that a greater quantity of sulphuric acid would be produced in a small room than in a large one, and with the same amount of gas, I should say, if there is a difference between a large room and a small room, the larger quantity would be produced in the larger room, because there would be still more air. Still, in a room of ordinary dimensions, it would probably not be large enough to transform the greater part of the sulphurous acid into sulphuric acid. The size of the room is almost infinitely greater than the size of the glass chamber under which these experiments were taken.

Mr. CRIPPS: Then, whatever may have been the immediate object of Dr. Letheby's experiments, your experiment in having first the contracted and then the larger tube showed you that sulphur was converted into sulphuric acid, if you gave it time?

Witness: Yes.

You have been asked whether Mr. Bowditch's process has ever been applied or not upon a large scale. Did I not understand you to say that you had tried it yourself?—Yes, I have tried it on a small scale repeatedly, and for a considerable length of time. On one occasion I remember passing the London gas, for a fortnight continuously, through a tube filled with lime, heated to a temperature of 500°, and during the whole of that time the sulphur, in what is called an irremovable form, was continuously and uniformly transformed into sulphuretted hydrogen, all except 4 grains per 100 cubic feet.

Then would that experiment lead you to believe that there is nothing to prevent it being adopted on some larger scale, and with success?—I cannot believe that engineers could not produce a result of that kind. It is so very simple, and the expense of getting the lime at 500° is so small, that it seems to me, therefore, to be no insurmountable difficulty. The only problem would be the applying it on a larger scale. It is a purely engineering question.

The CHAIRMAN: Do you believe that these sulphur compounds have any injurious effect upon the health of human beings?

Witness: I should have considerable doubt as to there being any appreciable effect produced upon persons in ordinary robust health, but for invalids and persons with weak respiratory organs, I think a good deal of suffering, at all events, would be produced. Whether there would be ultimate injury or not I should not like to say, not being a medical man.

Do you think that the difference between 15 grains and 35 grains, which is represented by employing this lime process, would have any appreciable effect upon the health of even an invalid?—I think so. I think the difference between two rooms, one lighted with gas containing only 15 grains, and another lighted with gas containing 35 grains, would be very considerable—in fact, I know it is from having experienced the atmosphere of the two rooms.

Then, perhaps, you are in a delicate state of health yourself, as regards the respiratory organs?—Certainly not; but I feel the effects of the sulphuric acid in the throat. There is a peculiar sensation similar to that which one perceives in a London fog. It is very much the same sort of thing, and it is very much stronger in a room lighted with gas containing the maximum amount of sulphur, as compared with a room in which there is the minimum amount of sulphur.

Then you have no hesitation in referring that to the different amount of sulphur compounds?—It is entirely due to the sulphur compounds.

Is there anything injurious to human health in the process of lime purification besides the disagreeable smell?—I should say decidedly not because of the offensive smell arising from sulphuretted hydrogen or sulphate of ammonia—and these are two reagents that are daily in use in chemical laboratories, and the students working in these laboratories are exposed to them very much more than persons would be to the lime from gas-works, and yet no injury to health results.

There is sulphur to some extent produced in any room where a full fire is being burnt, is there not?—There is sulphur produced in a fire, but it all escapes up the chimney. Unless the chimney smokes, no trace of it comes into the room.

Mr. *Arthur Herbert Church*, examined by Mr. CRIPPS.

I am a Fellow of the Chemical Society, and Professor of Chemistry at the Agricultural College, Cirencester. I have paid a good deal of attention to the compounds produced by the combustion of sulphur in gas. I have found generally that the whole of the sulphur in the gas may be converted into sulphuric acid when the quantity of sulphur is small; but when the quantity of sulphur is large, say over 30 to 35 grains in 100 cubic feet, a small portion of it, when the combustion is as perfect as you can get it, is still in the state of sulphurous acid; it does not go further; it does not get completely oxidized. But under the ordinary conditions of combustion, especially when a small quantity of gas is burned, and where there is an ample supply of air, the sulphuric acid is the only product of the combustion. I have had, from time to time, a number of specimens sent to me of leather binding from the upper shelves of libraries, chiefly private, but on some occasions public, and I have been asked to determine the cause why they were reduced, as one of my correspondents said, to the condition of Scotch snuff. I attributed it to the presence of sulphates in larger quantities than in natural dressed leather; that is, in leather that had been submitted to the process of dyeing, or something of the same sort. I also found that the watery extract showed a distinct acid reaction, due to the presence of free sulphuric acid. I attribute the presence of large quantities of sulphate in that disintegrated binding of books from upper shelves to combined sulphuric acid as well as free; to the action of the free produced by the burning of the gas on lime, and which prevented the whole of it being in a free state. The sulphuric acid, by its action upon the leather, combined with the lime, and formed sulphate of lime. I found a very large quantity of combined sulphuric acid, and a small quantity of sulphurous acid in the injured bindings. In completing this account, I ought to say, with reference to metals, that I have found crystals of sulphate of copper and sulphate of zinc, both due to the action of sulphuric acid on the copper and the zinc. They could only have been formed by the action of the free sulphuric acid produced in the burning of the gas upon the metals.

Mr. CRIPPS: You mentioned the effect upon leather. Are there any other articles upon which this effect could be observed, such things as fibre, and textures of different kinds—dresses, muslins, or the canvas of pictures; would it have any effect upon those?

Witness: My experiments have almost entirely related to the canvas of pictures, which have been found to become rotten when hung at a great height, and I have found more sulphates, and in a few cases free sulphate, from the watery extract of disintegrated canvas, which has been hung high up, while pictures that have been hung lower than 12 or 14 feet have been comparatively free from sulphate when removed from the same room.

Would it have any effect upon the oil and varnish of pictures themselves?—I found that some varnish resists the action of sulphate almost completely, but lac and shellac and mastic are rendered brittle, or the process of becoming brittle is accelerated—they do generally become brittle, but more quickly brittle when they are hung high up in a region which is hot, and laden with a larger quantity of sulphuric acid than the air of the room below.

Are there other materials on which it would have that effect—such as white lead?—I find white lead partially converted, in the upper walls of a room, into sulphate of lead, the walls injured, and the texture disintegrated, while the lead paint in the lower part was not in any way affected by the gas, or only to a very slight extent.

Its effects upon some other matters are well known to all of us, probably upon copper and brass metals; have you observed its effects upon those?—I have a copper vessel in my laboratory which has been heated with a paraffin lamp, and another similar one which has been heated for a like time at intervals for a similar purpose with gas-burners, and drops of strong solution of sulphate of copper are formed every morning on the one which has been heated by the gas-burner, while the other shows no appreciable corrosion except a small darkening of the surface, which is due to the action of the copper. This was at Cirencester, and out of the province of the metropolitan gas companies; consequently we have a very impure gas. I am not prepared to say what its general average of purity is.

Would it have any effect upon statuary and marble even in a museum?—I found it slightly rotted the surface of finely-polished statuary marble which had come from the hand of the sculptor; it was found to be slightly corroded, and I found that you could wash off sulphate of lime or gypsum, the same as often occurs in London upon the marble from sulphur that is burnt in coal. It is well known that you can extract from the stone of some parts of Westminster Abbey portions of sulphate of lime. I know as a fact that some of the best sculptors in England have what is called skin disease, and are undoubtedly affected by something. This may be partly due to the effect of sulphuric acid, and partly to other influences.

Under these circumstances, do you think that it would be desirable that means should be employed to take out these sulphur compounds from the gas which is to be in use generally in London?—I think so, upon the score of the preservation of the materials and objects, both useful and decorative, in our houses.

Cross-examined by Mr. PHILBRICK: I am not prepared to say that I would have all gas absolutely free from sulphur. What the restriction should be is a question I feel myself unable to answer. I would restrict it as far as it could possibly be done. I have not had my attention called to the limits prescribed in London by the Referees. I do not know that in the case of the Commercial Company it is 30 grains at the present moment. I am not prepared to speak authoritatively on the point as to how much sulphur there would be in the gas, supposing it was purified by the oxide of iron process. I have made one or two determinations from time to time of the sulphur contained in the gas at Cirencester, to see how much sulphide of carbon there was in it, solely for the purpose of attempting to purify the gas for my own use. I found a proportion which corresponds to about 35 to 40 grains of sulphur in 100 cubic feet, and in one case in which they did not take out the sulphuretted hydrogen, I found about 70 or 75 grains. Estimating the quantity at 35 grains, that would produce about 90 or 100 grains of sulphuric acid, or three times its weight. I have not made a calculation as to volume.

Mr. PHILBRICK: You have referred to some leather books, and so forth—some binding that had perished. Those bindings, I suppose, had been treated with size. You know there is acid in size, do you not?

Witness: There is, sometimes; but I made all my experiments of comparison with the leather which had been taken from a lower shelf of the same library.

Then it is just possible, unless you had the same identical binding in each, and leather treated in the same way and bound by the same man, that you might have size in the one case and not in the other?—Yes; still it would be very singular if all the leather on the top shelves contained the sulphuric acid. I do not know where those books were bound which came from the top shelf and which from the bottom. I have taken some myself from where gas was burning in the library at Cirencester.

In the library at Cirencester, where gas was burning, was the condition of the injured books which you have described the same generally in all the upper shelves?—It was the case with those books which were not frequently moved in the upper shelves—the two upper shelves. They suffered most, and those down near the floor but very little.

Have you ever read the late Professor Faraday's evidence on this subject

in the inquiry as to the Athenæum, and Professor Brand's?—In past time I have, but I have very little recollection of it now.

Cross-examination continued: I have not read Mr. Vernon Harcourt's researches upon this matter. I am aware that the atmosphere of all large towns contains more than a trace of sulphuric acid; but I am not aware that the top shelves of a library have a peculiar attraction for this impurity. I should not attribute any portion of the sulphuric acid in the atmosphere out of doors to the presence of sulphur in gas. I cannot say generally that the bindings of books suffer more from decay on the upper than on the lower shelves of a library, except where I have found gas to be burnt. Decay has never been brought to my attention in other cases. I cannot be quite sure whether I have had any experience except where gas has been burnt, because I have not had my attention drawn to it lately. I have had experience upon that fact sufficient to enable me to answer on oath, and give the committee a reliable opinion. Whatever investigations I have made have been made with reference to the presence of sulphuric acid in bindings. I hope I am chemist enough to know that in the pigments used by painters there is an acid present. In some there is chromic acid, in some carbonic, and in some acetic acid. I am aware that the mastic and other varnishes used by some painters for glazing and for the transparent tones of pictures do, apart from the use of gas lighting altogether, decay of themselves. I am not prepared to admit that they have therefore been abandoned, and that the reason why the tints of Sir Joshua Reynolds and other great masters fly, is because of the bad medium they used. I know it is the greatest reproach to an artist if he uses any amalgam or medium of that sort, as they do not stand. The megylf which used to be met with, which is half copal and half mastic varnish, is now, to a great extent, discarded by everybody who understands it. The ultramarine, which is used for the skies of pictures contains sulphur, and it has been found that where used the canvas has perished behind it.

Re-examined by Mr. Cripps: There are many materials used in painting and matters of that kind in which you can trace the effects of sulphuric acid. That is one of the strongest decomponents we have, and would leave its effect upon anything that could be decomposed in that way. I have, for the purpose of experiment as to the effects of sulphuric acid, compared the bindings of books on the higher shelves of libraries with those on the lower shelves in rooms where gas has been burnt, all other circumstances being, as far as I know, the same, and in those on the upper shelves I have found sulphuric acid.

By the Committee: I have been making these observations for about ten or fourteen years. I have a work upon the subject in preparation, and have been obliged to make experiments upon artistic materials for that purpose.

In those volumes which were sent to you, were they sent at your request with a view to your work?—A good many of those to which I have referred—and they all gave me the same result—were sent to me as a professed chemist to advise as to what was the cause of the destruction of the binding, and how far I could suggest a remedy, and I have always suggested complete ventilation.

I think you said that the more air the greater quantity of sulphuric acid would be formed?—Only that the more complete would be the product of sulphuric acid in the burning of the gas at first. It would all ultimately turn into sulphuric acid, therefore its effects would be the same, only that at the moment of preparation, before the burning is complete, you do not get it so completely formed.

Then the injury to the upper shelves of the bookcase would be caused, not by the sulphuric acid which was created at the moment of combustion, but from the sulphurous compound which afterwards turned into sulphuric acid?—Partly by the one and partly by the other.

Therefore you say the better ventilated the room is the greater the proportion of what would ultimately become sulphuric acid, and that would be produced at the moment of combustion?—Yes; and it would be carried away in a well ventilated room before it had time to do injury to the books. May I be permitted to say it was only portions of bindings from volumes that were sent to me, as a rule—only pieces of leather.

But the binding of the volumes—were you informed, when they were sent to you, whether they came from the upper shelves or the lower shelves of the library? Was your attention called to that fact?—In some cases it was; in some it was left for me to find out.

How did you ascertain that you were right in your supposition?—They were labelled. Those which I reported upon as containing sulphuric acid I was afterwards told were taken from the upper shelves. In some instances I never heard the result; I was merely asked my opinion without reference to where the book came from, or anything about it.

(To be continued.)

Legal Intelligence.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

FRIDAY, MAY 12.

(Before Vice-Chancellor MALINS.)

GLOSSOP *v.* HESTON AND ISLEWORTH LOCAL BOARD.

The plaintiff in this case is a gentleman residing at Silver Hall, Isleworth, and the action was brought against the District Local Board to restrain them from permitting sewage, or water polluted with sewage or other offensive matter, to pass through the drains or channels under their control into the river Crane, in such a manner as to render the water of the river, at or near the plaintiff's residence at Silver Hall, unfit for use by the plaintiff, and injurious to the health and comfort of the persons resident in such premises. An application was made some time ago for an injunction in the terms of the claim, but the application was ordered to stand over to give the defendants time to adopt any means they could of remedying the alleged nuisance. The plaintiff now stated that no steps had been taken by the board, and asked that the injunction be granted. It appeared that the river Crane came down from a district where there had lately been a large addition to the number of houses, and where the population had greatly increased. It then passed for about 200 yards through the pleasure-grounds belonging to Silver Hall, and afterwards emptied itself in the Thames above the grounds of Sion Park. It was shown that before reaching the Isleworth brewery the water in this stream was pure and clear, and the plaintiff alleged that the water used formerly to be perfectly clear when it reached his premises, but latterly it had become offensive to the smell, and injurious to the health of those who resided in the neighbourhood. The impurity had been gradually increasing for the last ten years, owing, as the plaintiff asserted, to the sewage of the new houses in the district being allowed to drain into the river instead of being carried away by some efficient means. A considerable amount of evidence was produced on both sides, and some of the witnesses were cross-examined. The plaintiffs evidence went to show that the water was now in a most impure state, and that he and his family had suffered severely in health in consequence thereof. The defendant's evidence, on the contrary, was to the effect that there was not the amount of nuisance which had been described; that the water was not impure, but was perfectly wholesome, even for drinking purposes; and the illness suffered by the plaintiff's family in 1874 was attributed to the effect of a cesspool belonging to the plaintiff's house, which had not been emptied for many years.

Mr. Glasse, Q.C., and Mr. Sturges addressed the Court for the plaintiff; Mr. Higgins, Q. C., and Mr. Methold appeared for the defendants.

The Vice-Chancellor, before hearing the counsel for the defendants, said if they would consent to the cause standing over for some months he would dispose of it now without hearing further argument.

Mr. Higgins, said the defendants would consent to this course.

The Vice-Chancellor said the nature of this case was very plain. The river Crane was formerly—that was to say, about 20 or 30 years ago—a very pure stream, in which, according to the evidence, one could see the pebbles at the bottom. This stream ran through the grounds of the house occupied by the plaintiff, in which he had lived for about six years, and which his father had occupied for about 30 years before him. During the last 10 years there had been a considerable increase in the population of the district, and the river Crane had gradually become less pure by reason of the drainage from the numerous houses that had been of late years erected in the neighbourhood. The plaintiff alleged that the water had become so impure that it could not be used for drinking purposes, and that the smell was so offensive that it prevented him from opening his windows on that side of his house, and produced disease among the members of his family. On the other hand, there had been evidence given contradicting this statement, and stating that the water was not by any means impure, and certainly not sufficient to cause illness to persons who resided in the neighbourhood; and one person, who was a miller lower down the stream, said there was nothing to complain of, and nothing which the defendants could be called upon to remove. Upon hearing the evidence on both sides, although he had not been addressed by the defendants counsel, he could not help coming to the conclusion that there was some ground of complaint, though it might not be so great as the plaintiff and his witnesses asserted. Then it appeared that the board of this district had had a notice served upon them by the Thames Conservancy, requiring them to remedy the nuisance now complained of, and if they did not comply with that order before Monday next they would be liable to a fine of £50 for every day that the nuisance remained. Considering the effect of that notice from the Thames Conservancy, and also looking to the desire which the board had expressed of doing all in their power to prevent further complaints, he did not think there was any necessity for granting an immediate injunction. It was evident that the board had great difficulty in deciding what was the best course to take, and the same difficulty existed in many parts of the country at the present day. After much deliberation, they had determined to adopt the "A. B. C." process of deodorizing the impurity by the use of alum, blood, and charcoal; but that plan had been stopped by the difficulty of obtaining a piece of ground for the purpose of their works. His lordship thought, in the circumstances, that it would not be right to embarrass the defendants further by granting an injunction. He gave the board full credit for their intention to remedy the nuisance, and he thought that the best order he could make would be to let the cause stand over for about nine months, and the pressure exercised upon them in the meantime by the Thames Conservancy would be sufficient to prevent any further delay in carrying out such works as should be finally decided upon. He should, therefore, direct the cause to come on again on the second cause day in Hilary Term, 1878.

CLERKENWELL POLICE COURT.—Monday, May 21.

(Before Mr. Barstow.)

BREAKING STREET-LAMPS.

Harry Philp, *Alfred Connolly*, and *Hubert Jefferys*, three youths, described as "gentlemen," were charged with wilfully breaking street-lamps at half-past three on the previous morning in Dartmouth Park Hill, Highgate.

A lamplighter said he saw the defendants throwing stones, there being no other persons in the street. A watchman in the street said he saw the defendants break three lamps in succession.

Mr. Barstow ordered the defendants to be imprisoned and kept to hard labour for fourteen days.

On the following day Mr. Humphreys, a solicitor, applied on behalf of the prisoners, that the magistrate would reconsider his decision.

Mr. Barstow declined to reconsider the matter, remarking that there had lately been several acts of wanton damage, and the prisoners, from their position, ought to have known better than to indulge in such mischievous freaks. He did not regret the decision he had come to in the case, and the matter being now out of his hands, the only course before Mr. Humphreys was to memorialize the Home Secretary.

A correspondent, writing to *The Times*, says: "I am glad to see that Mr. Barstow has set a good example by sentencing three young men, who were well dressed, and described themselves as 'gentlemen,' to fourteen days hard labour without the option of a fine, for breaking some street-lamps in Islington. I reside near Primrose Hill, which is provided with a number of handsome lamps, and it is really deplorable to see the number which are wilfully broken. A short time since I counted close upon 200 panes, and taking 12 consecutive lamps I found that 32 panes of glass out of 48 were broken—smashed to pieces. If the authorities would exercise a little more diligence, and the magistrates would follow the example set by Mr. Barstow, a stop would soon be put to so shameful a scandal."

Market Deeping Gas Company, Limited.—At the annual meeting on the 14th inst. a dividend of 6 per cent. was declared. During the past year the price of gas has been reduced to 5s. 10d.

Hull Gas Supply.—Mr. Baynes reports that the gas supplied to the district of Sculcoates and Myton by the British Gas Company during April gave the following results, free ammonia and sulphuretted hydrogen being at no time present to the ordinary tests:—

	Max.		Min.		Mean.
Illuminating power standard sperm candles	16·03	..	14·18	..	15·35
Grains of sulphur per 100 feet	30·50	..	28·40	..	29·38

Mean barometer 29·65; temp., 57°. In the east district, Mr. J. Baynes, jun., reports that the gas supplied to the above district by the Sutton, Southcoates, and Drypool Gas Company during the past month gave the following results:—

	Max.		Min.		Mean.
Illuminating power standard sperm candles	15·66	..	15·10	..	15·37
Grains of sulphur per 100 cubic feet	—	..	—	..	6·6
Grains of ammonia per 100 cubic feet . . .	—	..	—	..	22·6

Mean barometer and temperature in photometer-room: Bar., 29·62; temp., 56·3°.

London: Printed by William Boughton King (at the office of Clayton and Co., 17, Bouverie Street, Fleet Street); and published by him at No. 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, May 29, 1877.

THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[REGISTERED AS A NEWSPAPER.]

VOL. XXIX. No. 734.] LONDON, JUNE 5, 1877. [29TH YEAR.] Price 6d.

RAMSAY'S NEWCASTLE CANNEL COAL. Analysis—12,000 cubic feet of gas per ton of coal; 28-candle gas; coke, 66·70 per cent.; volatile matters, 33·30 per cent. Coke of good quality.

RAMSAY'S PATENT CONDENSED GARESFIELD COKE.

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GAS-RETORTS, introduced 1823. FIRE-BRICK WORKS, established 1804. FIRE-CLAY SANITARY PIPES, CHIMNEY-TOPS, and all Goods made of Fire-Clay. The Fire-Clay is worked from Blaydon Main Colliery, is of excellent quality, and no expense spared in perfecting every article. The FIRE-BRICKS (marked "RAMSAY") are to be seen in all parts of the world, and the Works are the most extensive in the Kingdom.

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FOUR PRIZE MEDALS. ESTABLISHED OVER 20 YEARS.

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They prevent and arrest rust, and protect iron from the action of water, sulphurous and gaseous exhalations.

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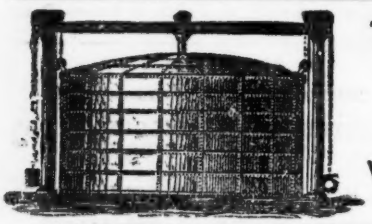

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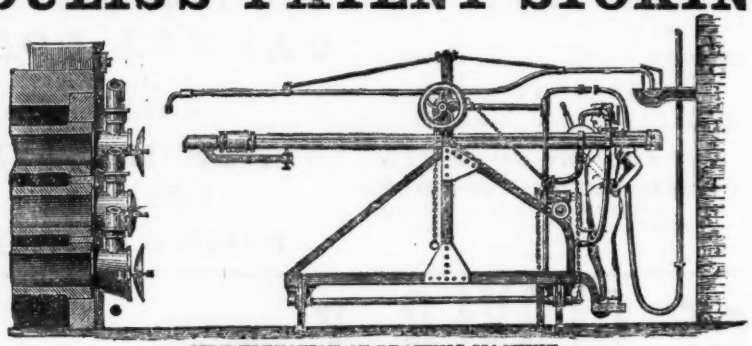
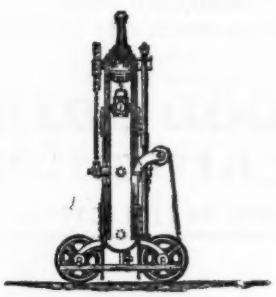


SIDE ELEVATION OF DRAWING MACHINE.



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(The Charging Machine will be Illustrated in next week's Advertisement.)

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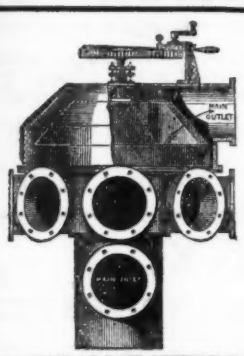

ELEVATION OF THE CENTRE-VALVE.

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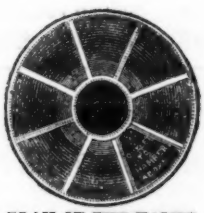
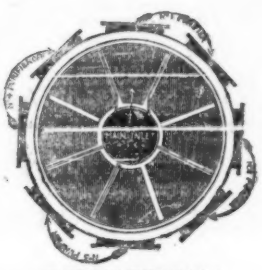
PATENT CENTRE-VALVES.



PLAN OF THE VALVE.



PLAN OF THE BODY.

These PATENT CENTRE-VALVES are the most perfect and certain means for working Purifiers on the system of three in action, and one out of action. The Valve itself is protected from all injury inside the safety cover. The working of the Valve is so easy, and so governed by the stop-catch movement, that the Purifiers can be instantaneously changed in the dark as well as in daylight. They are scraped perfectly true, metal to metal, the facings heretofore exposed are always covered, and there is nothing more reliable, certain, and durable in a gas-works. By their use the floor of the Purifying-house is clear and level; the Valve and all connexions being beneath the floor, out of the way of working. A considerable improvement and saving is effected in the cost of the connecting-pipes.

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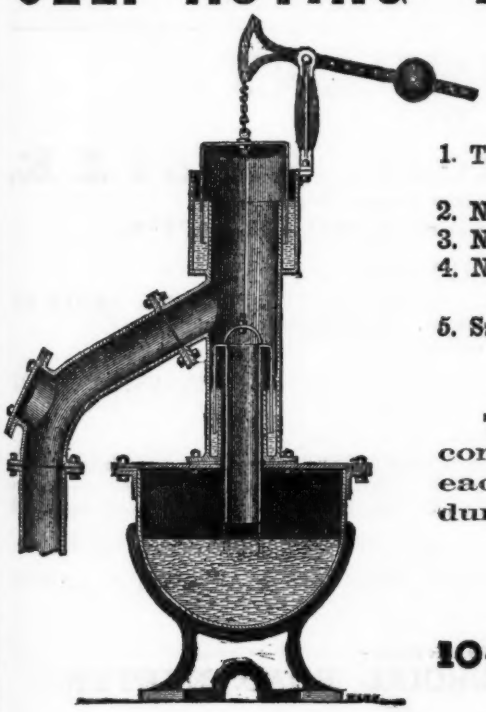

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6. Gets 10 per cent. more Gas out of the Coal, and a higher Illuminating Power.
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These Dip-Pipes can now be supplied complete, except the flanched bend, for £4 each, which includes the charge for licence during the whole term of the patent.

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In the construction of this Meter, for which the best tin plates only are used, every mechanical contrivance has been taken advantage of successfully to reduce the friction to a minimum, which is amply proved by the fact that they are made to work upon only one-fortieth of an inch pressure. By an improvement also in their construction, a steadier light is obtained, and greater capacity than can be got from any other Meter in the market. No gas can pass under the valves on any back pressure, as is the case with many other Dry Meters.

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IMPROVED GAS-VALVES

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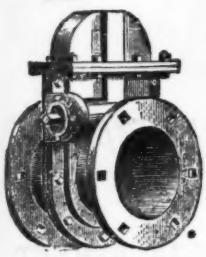

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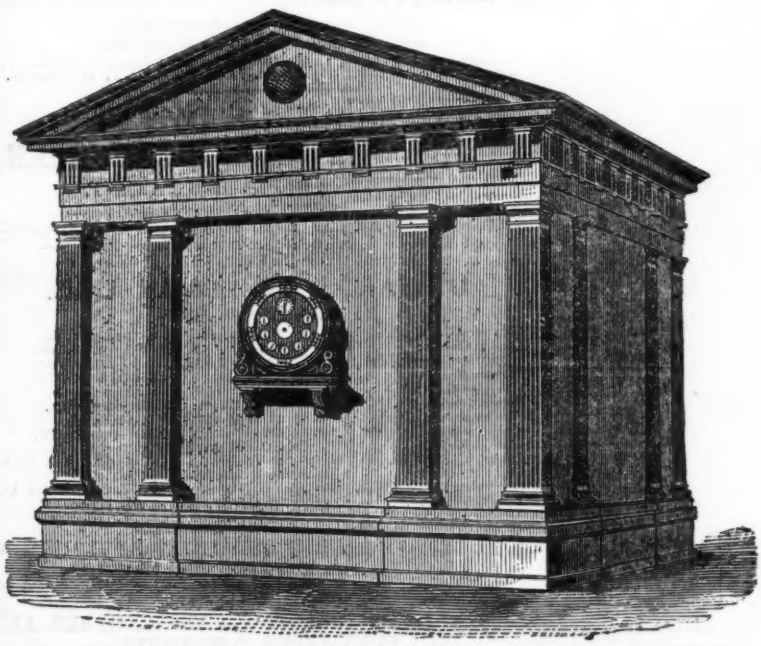

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Home and Foreign Orders promptly attended to.

All Sizes of CONSUMERS METERS, STATION-METERS, and GOVERNORS generally in Stock.

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For excellence of Fire-Clay Gas Retorts, and "HONOURABLE MENTION" for good quality of Fire-Bricks.

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WOOD PURIFIER SIEVES,

Which have now been used for fifteen years, and their advantages and durability fully established. They are made entirely by steam machinery in very large quantities at the most moderate cost.

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ESTABLISHED IN 1860.

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Keep in London and at their works large stocks of PIPES and CONNEXIONS (1½ to 36 inches in diameter); also make and supply Retorts, Tanks, Columns, Girders, Special Castings required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.
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Manufactory for every description of Casting and Machinery for Gas-Works and Water-Works.
Warehouse in London for Cast-Iron Pipes and Connexions of all sizes and in any quantity, Scott's Wharf, Bankside, Southwark.
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Near SHEFFIELD,
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BEST STOURBRIDGE FIRE-BRICKS, LUMPS, AND CLAY RETORTS
Of all Dimensions for Gas-Works,
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Of every kind.
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PREVENTS WASTE OF GAS FROM RETORTS;
SAVES CLAY RETORTS FROM DESTRUCTION BY FIRE;
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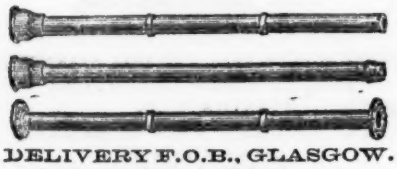

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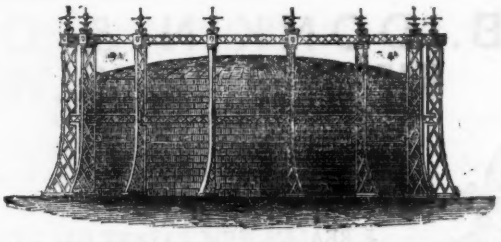

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MANUFACTURERS OF
GASHOLDERS, WROUGHT AND CAST IRON TANKS, CONDENSERS, PURIFIERS, SCRUBBERS, MAINS, RETORT-LIDS, PLAIN AND DISHED, LAMP-POSTS, PIPES,
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ALSO
MAKERS OF ROOFS, BRIDGES, &c.

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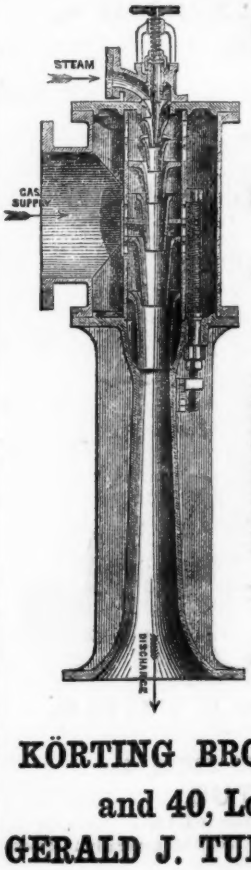
Steam-Jet Engineers,
7 and 17, LANCASTER AVENUE,
MANCHESTER,
AND 40, LOWER GARDINER STREET, DUBLIN.



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STEAM-JET GAS-EXHAUSTER.
IMPROVED CLELAND'S PATENT.
Small Cost—Compactness—Perfectly Self-Acting—Self-Regulating—Self-Cleansing—No Steam-Engine—No Attention—No Extra Room Required—No Wear and Tear—No Noise—No Oscillation in Vacuum, or Back Pressure.
UPWARDS OF 200 IN USE.
SUPPLIED TO—

Chartered Gas Co.	Glasgow Corporation.	Hanna, Donald, and Wilson, London.
London Gas Co.	Leyland Gas Co.	Ratcliff Gas-Works.
S. Metropolitan Gas Co.	Stalybridge Gas-Works.	Kendal Gas-Works.
Phœnix Gas Co.	Lincoln Gas-Works.	Longton Gas Co.
Liverpool Gas Co.	Birmingham Gas-Works.	Dartford Gas Co.
Bolton Corporation.	Wakefield Gas-Works.	Exeter Gas Co.
Horsham Gas Co.	Brentford Gas-Works.	Harrogate Gas Co.
Epsom and Ewell Gas Co.	Burnley Gas-Works.	Hertford Gas Co.
Ipswich Gas Co.	Guildford Gas-Works.	Waterside Gas-Works, Todmorden.
Cheltenham Gas Co.	Gloucester Gas-Works.	F. W. Grafton and Co., Accrington.
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E. KÖRTING'S PATENT STEAM-JET REVIVIFYING BLOWERS FOR THE PURIFYING MATERIAL.
SOLE LICENSEES FOR
W. CLELAND'S PATENT STEAM SCRUBBER AND SLOW-SPEED CONDENSER.
FOR PARTICULARS, APPLY TO
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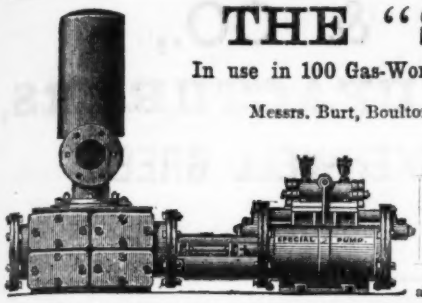
and 40, Lower Gardiner Street, Dublin,
OR TO
GERALD J. TUPP, 8, John Street, Adelphi, W.C.,
LONDON,
SOLE AGENT FOR ENGLAND AND WALES.

THE "SPECIAL" STEAM-PUMP.



In use in 100 Gas-Works in the United Kingdom for Pumping Ammoniacal Liquor, Water, or Tar.

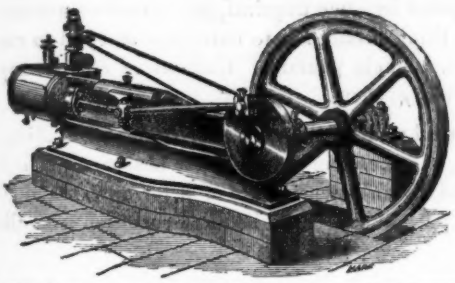
Messrs. Burt, Boulton, and Haywood, Manufacturing Chemists, have FORTY "Special" Steam-Pumps in use at their several large Tar-Works.

200 Sizes made. The following are the Leading Sizes for Gas-Works:—

Steam Cylinder . . . in.	3	4	3	5*	5*	4	6*	5	7*	6	8*	7	10*
Water Cylinder . . . in.	1½	2	3	2½	3	4	4	5	5	6	6	7	7
Gallons per hour . . .	450	815	1830	1250	1830	3250	3250	5070	5070	7330	7330	9750	9750
Price	£16	£18	£18	£21	£22½	£25	£30	£32½	£40	£50	£50	£50	£65

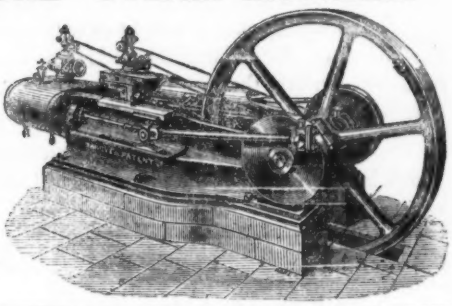
* These Sizes being usually selected for pumping Tar and Liquor, are always in stock, or nearly ready, fitted with all pump details in iron, and extra length distance-piece between steam and pump cylinder, at a small extra cost.

TANGYE'S HORIZONTAL HIGH-PRESSURE STEAM-ENGINES.

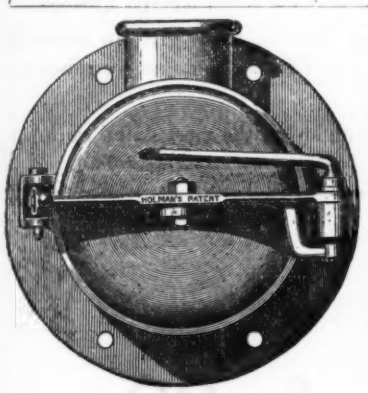


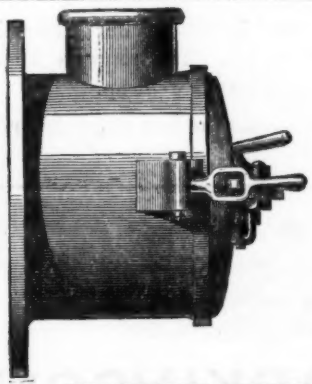
THE DESIGN,
WORKMANSHIP,
AND
LOW PRICE
OF THESE ENGINES
HAVE CALLED FORTH
UNIVERSAL APPROVAL.

Over 2000 Sold
Since December, 1869.



SIZE	B	C	D	E	G	H	I	J	K	M
Nominal Horse Power	TWO	THREE	FOUR	SIX	EIGHT	TEN	TWELVE	FOURTEEN	EIGHTEEN	TWENTY-FIVE
Price of Engine, with Governor	£28 0	£38 0	£46 0	£70 0	£90 0	£115 0	£127 0	£140 0	£195 0	£220 0
Feed-Pump, extra.	3 0	3 15	4 0	5 10	6 0	7 10	7 10	8 0	10 0	15 0
Variable Expansion Gear, extra	..	..	..	..	13 0	14 0	15 0	15 0	20 0	25 0





MORTON'S
Patent Self-Sealing
RETORT LIDS,

WITH

HOLMAN'S NEW PATENT BRACKETED CROSS-BARS, ANTI-FRICTION CATCHES, AND ECCENTRIC FASTENINGS.

Instantaneous Sealing effected. No Luting. No Duplicate Lids required. Holman's New Self-Sustaining Cross-Bar ensures freedom of joint, and maintains parallel position of the Lids.

Since their introduction in 1869, these Patent Retort-Lids have been thoroughly tested (rigid cast iron is now successfully employed), nearly 25,000 being in use at various Gas-Works in London and the Provinces.

IMPORTANT TESTIMONIAL.

The Gaslight and Coke Company (commonly called the Chartered Gas Company), Beckton, North Woolwich.

Gentlemen,—In answer to your inquiry respecting the Self-Sealing Lids, I beg to say that they continue to work well, and I have every reason to be satisfied with them. I should be very sorry to return to the old system of Luting, and our stokers here freely acknowledge the benefit to them of the new system.

I am, yours truly, (Signed) G. C. TREWBY.

HUNT'S PATENT EQUILIBRIUM GAS-GOVERNOR.

In this Governor a Throttle-Valve is substituted for the ordinary suspended Cone, all external communications being avoided by placing the Lever or Radius Arm (shown in the drawing) inside the Valve-Chamber upon the Disc. The Disc is carried upon steel centres, upon which it is accurately balanced and turns freely. The friction in working is thereby reduced to a minimum. This Governor is extremely sensitive to alterations of inlet or outlet pressure, and renders a large actuating holder unnecessary.

The principal advantages of this arrangement over the ordinary form of Governor are as follows:—

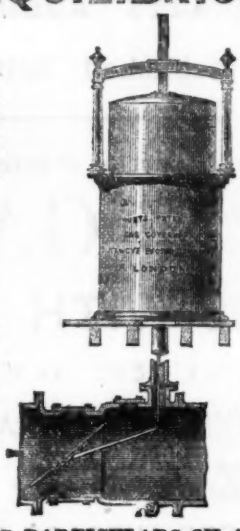
Its sensitive action prevents oscillation.

It is self-adjusting—*i.e.*, it maintains a steady pressure under variations of inlet pressure or a fluctuating consumption.

The inlet to Gasholder being contracted to the smallest possible dimensions, all danger from leakage through insufficiency of seal, tilting, &c., is entirely avoided.

The valve portion being separate from the holder, it can be handled and fixed like an ordinary Slide-Valve direct in the main; and the holder can be placed at any convenient distance immediately above it. The cost is thus materially reduced, and the inconvenience of heavy lifts done away with.

There are no working parts likely to get out of order.



These Governors have been adopted by many leading Gas Companies, among whom are the following:—

The Gaslight and Coke Co. (9), The London Gas Co. (3), and at Abergavenny, Arundel, Birmingham, Cannes (France), Devonport, Dronfield, Dursley, Exeter, Guernsey, Mentone (France), Monmouth, Newcastle-on-Tyne, Oxford, Plymouth, Rochdale, Windsor, &c.

TESTIMONIAL.

The Gaslight and Coke Company,
9, Water Street, New Bridge Street,
Blackfriars, E.C., Feb. 27, 1875

MESSRS. TANGYE BROTHERS AND HOLMAN.

Gentlemen,—The two 24-inch and three 36-inch Hunt's Equilibrium Governors supplied by you, and fixed in the valve-rooms at Whitechapel, Goswell Road, and Blackfriars, are working very satisfactorily.

Yours truly,

(Signed) JOHN JOHNSON.

PRICES AND FULL PARTICULARS ON APPLICATION TO

TANGYE BROTHERS & HOLMAN,

SOLE MANUFACTURERS,

LAURENCE POUNTNEY LANE, LONDON, E.C.

THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

214 TO 222, ST. JOHN STREET, CLERKENWELL GREEN,

LONDON, E.C.

TO GAS ENGINEERS AND MANAGERS.

It having come to our knowledge that a report is in circulation, spread by some unprincipled person or persons, that the cases of our larger-sized Meters are made of Galvanized Iron, we think it only fair to ourselves, and just to our customers, to say, that we never have used, in making any of our Meters, a single pound of *Galvanized Iron*, or any other *cheap* and *inferior material*, and this can be easily seen by opening any of them.

The cases of our large-sized Meters, from 20 lights and upwards, are all made of the very *Best Best Patent Alloy*, which is nearly double the price, and will last more than double the time, of some other material that has been and still is very largely used for the same purpose. And our experience, acquired by an extensive use of it for upwards of 30 years, enables us to say with confidence that no other metal in use for the purpose is so little liable to corrosion from the action of the gas.

We have now in use a Meter made in 1848, and therefore 29 years old, the case of which is made of Patent Alloy; the Meter is still in perfect order, and shows no signs of decay.

The utmost care is exercised by us in selecting none but the very best materials for all parts of our Meters; much of it is made *expressly for us*, as it is not possible to obtain it in the open market of the same superior quality.

The great fall in the price of all materials used in making our Meters has enabled us to give an increased discount, thus giving our customers the benefit of the fall. This we were bound in fairness to do, as we raised the price of our Meters four years ago, when the price of all metals went up.

It will be our constant endeavour, by using none but the best materials, and employing the most skilful workmen, to maintain the high character our Meter has hitherto borne.

WILLIAM PARKINSON & CO.

(SUCCESSORS TO SAMUEL CROSLEY,)

COTTAGE LANE, CITY ROAD, LONDON, E.C.

Established 1816.

MANUFACTURERS OF PATENT

WET & DRY GAS-METERS,

STATION-METERS WITH PLANED JOINTS,

GOVERNORS, PRESSURE REGISTERS, GAUGES,

AND EXPERIMENTAL APPARATUS,

STREET-LAMP METERS,

AND REGULATORS FOR AVERAGE METER INDICATION.

METERS FOR MEASURING WATER.

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JUNE 5, 1877.

Circular to Gas Companies.

THE topic of the greatest interest to all Gas Companies, that presents itself to our mind is one which we can only lightly touch upon. It is the great "sulphur" question, as presented to Parliament by The Gaslight and Coke Company. This is not merely a metropolitan question. It concerns, directly or remotely, every Gas Company in the kingdom. Those who now possess statutory powers will have to apply for further, and year by year non-statutory companies will be in Parliament for special Acts. The case now before a Select Committee of the House of Commons will necessarily have a very important bearing in relation to these measures. If the Chartered Company be relieved from all obligations to purify gas from "sulphur," no other Company need trouble themselves about the matter. If, on the other hand, the Legislature insist that "sulphur" shall, as far as possible, be removed from gas, then we may be certain that more stringent restrictions will follow than any yet imposed. This case has drawn attention to a matter which was almost forgotten. There has been next to no agitation on the "sulphur" question for more than ten years, and its revival to-day is greatly to be regretted. The peculiar circumstances of the Chartered Company, however, rendered the revival unavoidable, and they and all must put up with the consequences.

The deliberations of the Committee will be resumed this morning, and there is a general impression that they will soon be concluded. It is, however, rumoured, as we said last week, that the opponents of the Company will seek to bring forward a good deal more evidence on a point on which the Committee appear to have made up their mind—viz., the damage done by sulphur in gas. Now, the Committee seem to consider that there is a balance of evils. On the one hand, purification by lime occasions a nuisance in the neighbourhood of gas-works, and, on the other hand, they seem to admit that sulphur may be the cause of some injury to goods. Which is the greater evil—the nuisance or the damage? A decided answer to this question involves the success or rejection of the measure promoted by the Chartered Company. We are, of course, precluded from expressing any opinion on the matter at the present moment.

There is, however, one point to which we have already made a brief reference, and that is an expression of opinion on the part of the Chairman, that if relief be granted to the Company it should be accompanied by some reduction of the initial price of gas by way of compensation to the public. A decision of this kind, we may take it, would be satisfactory to neither party. It is not a question of price with the two opposing authorities, who are perfectly satisfied with the arrangements made last year, which are working with undoubted advantage to the public. Nor could the Company for a moment accept the relief they seek, accompanied by a reduction of price. On this point, however, enough was said last week, and we need only refer to a matter which has cropped up since. Most, if not all, of our readers will, no doubt, have seen in the public prints a report of the proceedings at the Miners Conference, held last week, and will have noticed how narrow an escape we have had from an artificial coal famine. It was seriously proposed, and nearly decided, to enter into a general combination to diminish the output of coal, with the object of advancing prices. Of course, the first effect of such a combination would have been felt by coalowners and contractors; but it would presently have produced serious consequences to Gas Companies. As it is, it may be expected that coalowners, finding themselves exposed to such a contingency as that which has lately been avoided, will be rendered more cautious in making contracts, and will be induced to demand higher prices.

There is just now another matter to which we may here call attention. The war has sent up freights to a considerable extent, and this will have the effect of making an addition to the cost of coal, which, in the case of the Chartered Company, may amount to no inconsiderable sum. Giving, then, due weight to these several considerations, and estimating dispassionately the effects of such contingencies and realities as we have mentioned, we repeat that it would be the height of injustice for the Committee to insist on a reduction of price which will satisfy no one. This is, however, a question of clauses not involved in the Bill as presented to the Committee, and we must leave it to the serious consideration of the party most concerned. We entertain a strong opinion that the proceedings will be brought to a close to-day, or at the latest to-morrow. The Committee are evidently tired of the business, and will probably refuse to listen to evidence beyond that they themselves have requested. In any case we are certain to be able to report the final result in our next.

The rumour again obtains that Earl Redesdale is about to retire from the post of Chairman of Committees of the House of Lords. In spite of the fact that we have always regarded his lordship's influence as inimical to the interests of Gas Companies, we shall greatly regret his retirement. Earl Redesdale is a man of fixed ideas, and always knows his own mind, and if you went before him you knew what to expect. He has set a mark on the Gas Legislation of the last ten years, which will remain until the conditions of things are altogether different from what they are to-day. We look about the Upper House in vain for a successor who will combine his knowledge of, and aptitude for, business with such perfect impartiality.

The JOURNAL OF GAS LIGHTING, &c., as all our readers know, has no politics, and, if we now refer to Mr. Gladstone's visit to Birmingham, it will have no reference to the ultimate objects of that demonstration, whatever they may be. We would simply remark on the speech made at the Mayor's banquet, on which occasion Mr. Gladstone sang a pæan in praise of the doings of the Municipality of Birmingham. He praised the condition of the streets, and the police and watching arrangements; he noticed the means provided for public recreation, which he very correctly observed were largely contributed to by private liberality; but, so far as we can learn, he said no word on the greatest enterprise of the Town Council, and the crowning achievement of his host, Mr. Chamberlain, M.P.—namely, the acquisition of the gas and water undertakings supplying the borough. It can hardly be supposed that Mr. Chamberlain had left the great statesman in ignorance of a transaction that cost the Municipality more money than they had ever before expended, and laid a heavy weight of debt on their shoulders. What inference, then, may we draw from Mr. Gladstone's silence on this, the greatest enterprise the Corporation of Birmingham have ever entered upon? Are we to suppose that

he, as a political economist, does not regard with favour the possession of commercial undertakings by Municipal Authorities? We hesitate to draw such an inference, but it might almost be justified. Sound political economy we believe to be entirely opposed to the acquisition of commercial undertakings by Municipalities. There may be something to be said in favour of the supply of water, which is a necessary of life, by a public body, but not more than, if so much as, might be alleged in favour of a public supply of bread and meat, which are equally necessaries of life. The manufacture and distribution of gas, which is rather a luxury than a necessity, is a different matter, and is a purely commercial business, which is always better left in the hands of commercial men. Possibly, Mr. Gladstone knows this, and hence his silence on the greatest achivement of the Corporation of Birmingham. As some of our friends in Birmingham are very sensitive, we may assure them that there is nothing in the foregoing remarks which at all reflects on the conduct of the Corporation in acquiring the undertakings, or in their subsequent management. On commercial and economic grounds, we are strongly opposed to the possession of commercial undertakings by Local Authorities. They have, in no single instance, done better for a community, and, in some notable instances, have done nothing like so well for consumers, as the legitimate purveyors of gas would have done. We say nothing about advantages to ratepayers, which would involve the indirect taxation of gas consumers; we simply refer to the undertakings as commercial enterprises, and we may express a strong opinion that their general absorption by Local Authorities would be fraught with disaster. There are not even now sufficient sound investments to employ the savings of the country at a really remunerative rate, and we may safely say that the purchase of every gas undertaking involves the loss of a large amount of productive capital to this country.

The "electric candle" continues to attract some attention in Paris, where it has caused a fall in the value of shares in the Gas Company. Generally, however, in the French gas world, it is not regarded as a formidable rival to gas illumination. A new contemporary, the *Journal des Usines à Gaz*, discusses the matter in a very temperate spirit, pointing out the limited applications the light can receive, its dazzling whiteness, which soon fatigues the eye and renders it impossible to work long by its aid, and its non-diffusibility. In the experiments at the Magasin du Louvre, we believe the candles are shaded by opaque glass globes, which, no doubt, render the light tolerable by cutting off seventy or eighty per cent. of that furnished by the candle. We have no information as to the cost of the light, but our contemporary somewhat sarcastically remarks that at present its use is certainly more economical than gas, for it is supplied gratis.

The City of Brussels have some gas-works of their own, a report on the working of which, during the past year, has recently been presented to a Special Gas Committee of the Communal Council, which seems to show that the undertaking is not a brilliant success. The profit made last year was only about three and a half per cent., and the gas unaccounted for was about 31 per cent. of the make. Public lamps intended to consume from 140 to 200 litres of gas per hour actually burned 250 litres. The grave defects which allow of this enormous loss of gas are being remedied, and a hope is expressed that the leakage will soon be reduced to ten per cent. of the production. The mains appear to have been originally laid in the most careless manner, so that the pressure at various points has been extremely irregular, and in consequence some districts got scarcely any gas at all when, as we gather, the initial pressure was four inches. The report says little for the municipal management of a gas undertaking in Brussels.

The Town Council of Exeter are, apparently much against their will, compelled to prosecute the Gas Company for a nuisance. The Company, while denying that the stenches complained of emanate from their works, are, nevertheless, by diligently making alterations, and setting up improved apparatus, doing their utmost to remove the possibility of complaint. Under these circumstances, a prosecution must necessarily fail, and the money spent on it will be thrown away. A very unsatisfactory state of affairs in relation to gas matters has prevailed in Exeter for some time past, which we shall be glad if this prosecution clears away. We have no doubt the Company will establish a good case for themselves, and then the agitation must cease.

At a special meeting of the shareholders in the Blackburn Gas Company, held last week, a resolution was unanimously passed approving the terms of purchase and sale arranged between the Corporation of Blackburn and the Directors of the Company.

In answer to a correspondent, whose letter relating to our remarks on Aitken and Young's process we published in our last, we may say that the remarks we made were based rather on the specification of the patent than on the experiments at Hamilton. This document proposes a wider and somewhat different application of the process than that suggested for Scottish works, where, as we understand, water gas is not made.

Water and Sanitary Notes.

THERE are still, it seems, innocent people in Lambeth, who imagine that they can get rid of their indebtedness by the simple process of refusing to pay their debts, and therefore, we may imagine that the Lambeth Police Magistrates will presently be occupied with some hundreds of summonses. A test case will, of course, be selected, the decision on which will govern all the others. The eyes of the silly people will then be opened to their folly. They will pay the cost of the summons in addition to the water-rate, and will leave the Court wiser, if not richer men. It is lamentable to see men, who ought to know better, advising resistance and repudiation, but we suppose something must be done to earn and keep a seat in the Metropolitan Board of Works.

The inquiry before Mr. Thornhill Harrison, C.E., one of the Local Board Inspectors, relative to the scheme promoted by the Corporation of Birmingham for the formation of a united district for the sewerage of their borough and the neighbourhood was brought to a prompt conclusion by the vigorous action taken by the Town Council. The lawyers evidently wanted to make a long job of it, and the inquiry promised to be interminable. Opposition sprang up from Local Boards which was not anticipated, and, indeed, in cases in which it was understood that a common agreement had been arrived at. Under these circumstances, the Town Council of Birmingham cut the matter short by authorizing their Sewage Committee to withdraw the scheme if they thought fit. That brought the opposing Boards, or rather lawyers, to their senses. They immediately accepted the scheme, subject to an appeal on some minor points to the Local Government Board. It should be mentioned that West Bromwich is left out of the scheme.

Now, the Town Council have to deal with Sir Charles Adderley, who insists that provision shall be made for the separation of storm water from sewage. It is, of course, competent for the Local Government Board to make an order that this shall be done, but, as the doing of it will cost the Corporation of Birmingham alone something like a quarter of a million of money, they would withdraw the scheme rather than assent to it. The proposal is, in the highest degree, absurd; for if the plan were carried out, the river Tame would soon be choked with the *débris* of Birmingham roads, which is now stopped at Saltley.

We have nothing further at present to report on the Lower Thames Valley drainage scheme, over which, we presume, there will shortly be a great fight. There is nothing, we fear, to be done in this case, but for the Local Government Board to make a peremptory order constituting the united district.

GAS EXPLOSION ON BOARD SHIP.—A Board of Trade inquiry has just been concluded at Liverpool, before Mr. T. S. Raffles, stipendiary magistrate, and Captains Grant, R.N., and Wilson, nautical assessors, as to the cause of an explosion on board the steamship *Levant*, on the 28th of April, in the Bay of Biscay. The *Levant* was on a voyage from Cardiff to Gibraltar, with a cargo consisting of 830 tons of South Wales steam coal, and on the 28th of April a fireman lighted a match in the forecastle, this act being immediately followed by an explosion of gas that had generated among the coal. Five men were injured, one of them fatally. The Court gave judgment on Wednesday. They considered that the explosion was clearly caused by the want of proper ventilation, which caused an accumulation of gas in the forecastle, and that this was exploded on a match being incautiously ignited. It would appear that the South Wales steam coal was of a peculiarly gaseous nature, and a similar catastrophe, owing to this cause, occurred only last year at Cardiff, in the case of a sailing vessel called the *Atalanta*, resulting in a greater loss of life than in the present case. It was suggested in the report of the inquiry held with regard to the *Atalanta*, that all vessels carrying coal should be provided with proper deck ventilation, and the Court, in the present case, entirely concurred in that expression of opinion. In this case the master, who had had considerable experience in carrying South Wales coal, did not anticipate any danger in going to sea on the morning of the 26th of April. Unfortunately, the state of the weather did not allow him to open the hatches until the morning of the 28th, and there was not sufficient time for the accumulated gas to escape before the match was struck which ignited it. This second catastrophe, following so soon after that of the *Atalanta*, satisfied the Court that it was absolutely incumbent to provide that all vessels carrying a similar cargo should be fitted with efficient deck ventilators, and the Court recommended this question to the serious consideration of the Board of Trade. The Court acquitted the master of any default, considering that the explosion which took place was owing to an accident which he could not foresee. It was elicited in the course of the inquiry that neither the managing owner nor the master of the *Levant* was aware of the case of the *Atalanta*. During the inquiry one of the witnesses casually intimated that the master of the *Levant* was under the influence of drink on the day when the vessel left Cardiff, and at the time she left. This was contradicted by all the other witnesses, and the Court did not give credence to the accusation; and it should be added that the man who made it had been "logged" for absence from his ship without leave. The captain's certificate was then handed to him, and the inquiry closed.

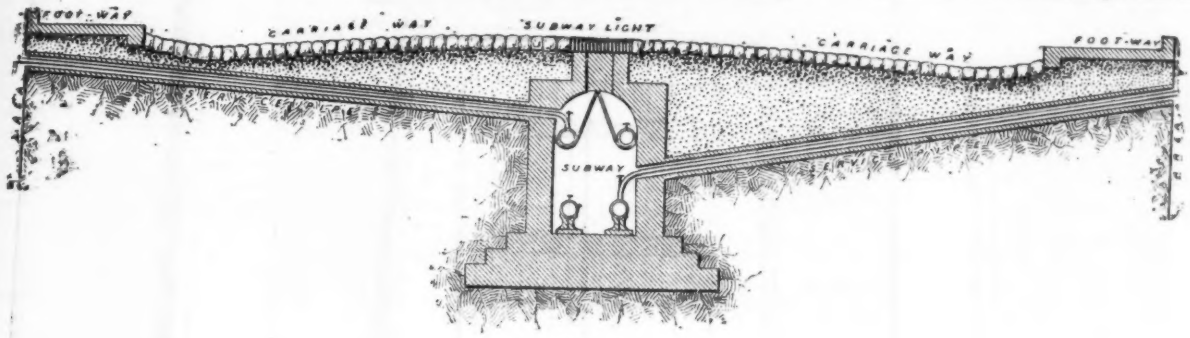
A TREATISE ON THE SCIENCE AND PRACTICE OF THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

CXXXVII.

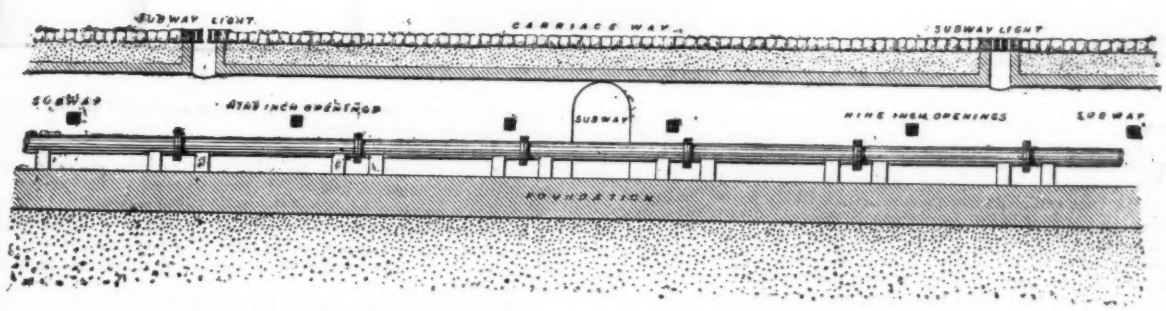
SUBWAYS (*continued*).

The first suggestion for constructing subways underneath the streets of London was made by Mr. John Williams, a stationer, in Cornhill, in a letter dated Aug. 27, 1817, addressed to Mr. Michael Angelo Taylor, at that time Member of Parliament for Durham. In the year mentioned, a Bill was introduced by Mr. Taylor, and passed, for removing obstacles and nuisances from the streets of the Metropolis, and regulating the paving and public lighting.

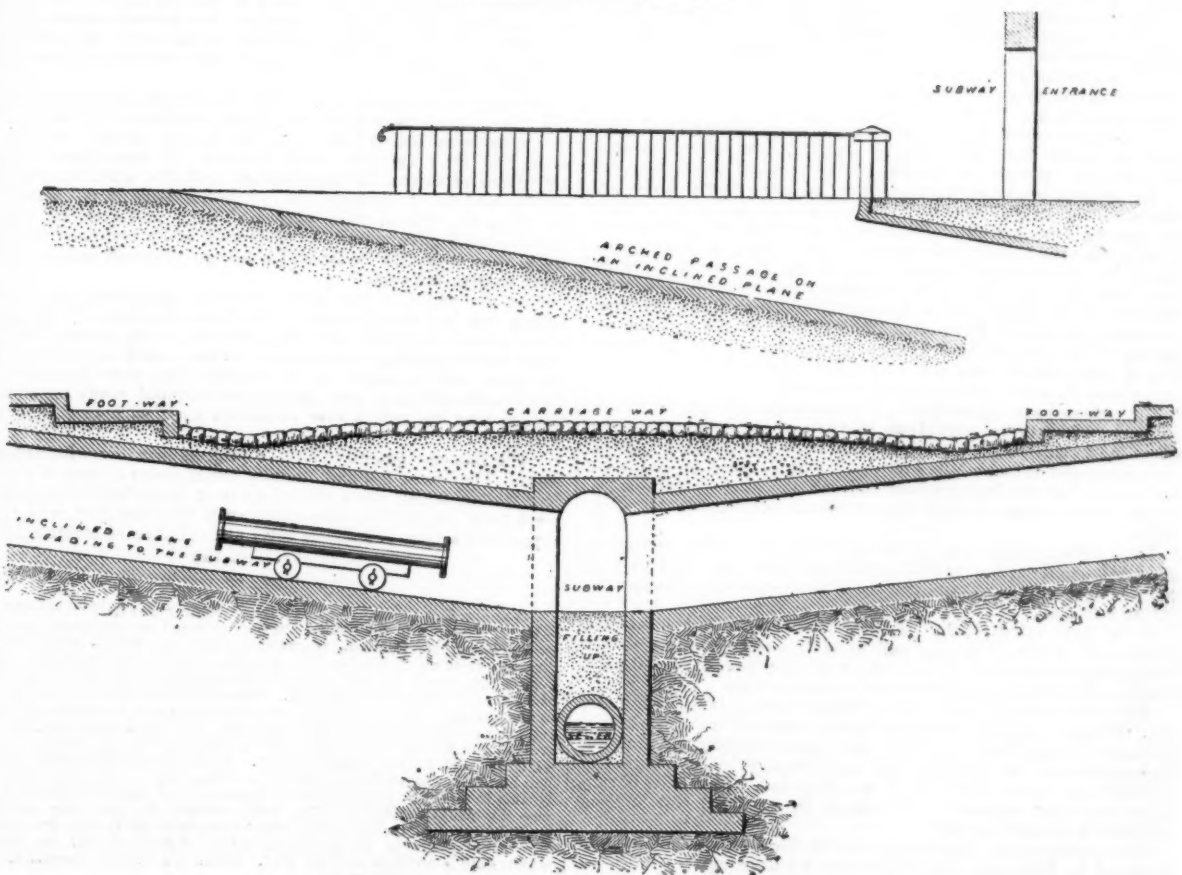
This Act, which proved highly useful in clearing the pavement of wheelbarrows, and impediments generally from the public way, and also prevented projections from shop windows and doors, which had become an intolerable nuisance, led Williams to address a letter to the author of the Act, to the effect that as the labours of the committee of the House of Commons on the Act for improving the paving of the Metropolis, of which Mr. Taylor was the chairman, were likely to produce considerable benefit to the public, he took the liberty, with much deference, to offer to his notice, in furtherance of that object, an idea which he believed was capable of rendering the views of the House, in addition to the Act of Parliament recently enacted upon that subject, thoroughly complete. "It was," he stated, "perfectly attainable, to prevent the pavement, when once laid, from ever being disturbed for any purpose whatever; and as the simplicity of the plan, when explained, might create a question of its originality, although it had never been adopted, or indeed thought of, he proposed to submit the idea to Mr. Taylor as the



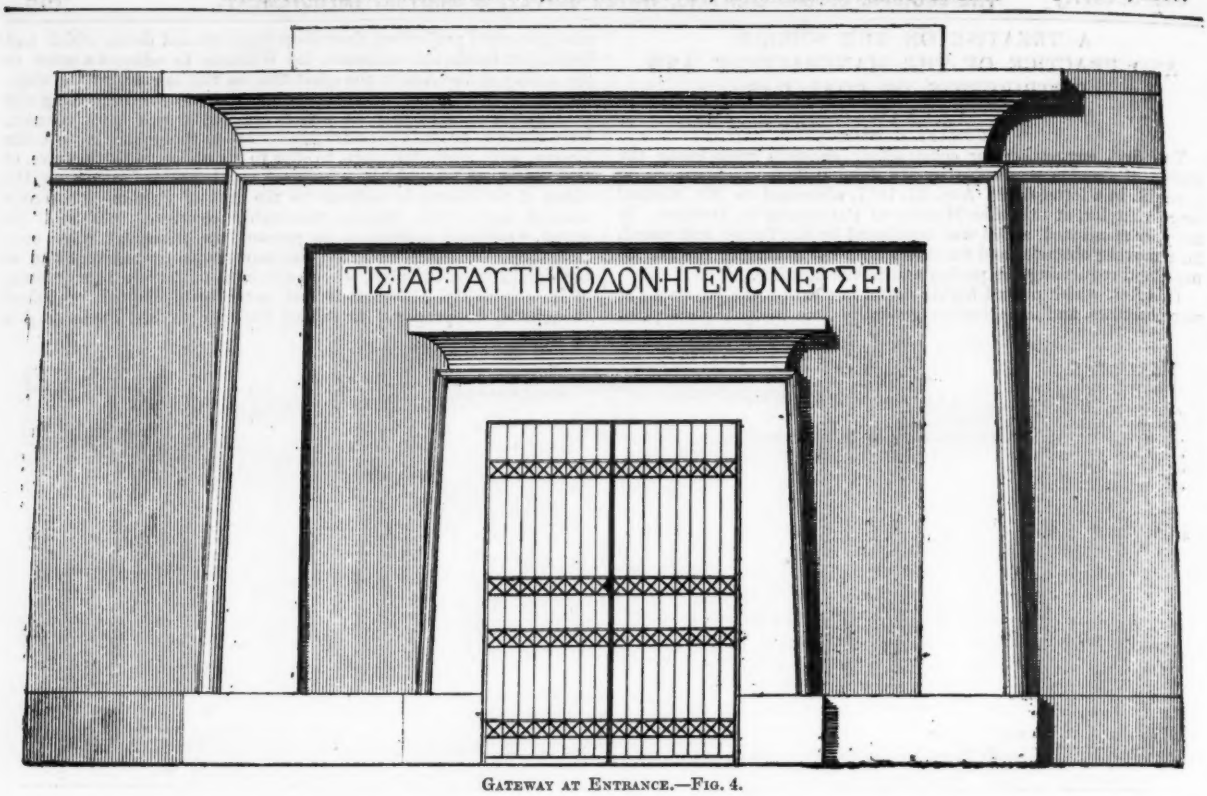
TRANSVERSE SECTION.—FIG. 1.



LONGITUDINAL SECTION.—FIG. 2.



SECTIONS SHOWING THE ENTRANCE TO SUBWAY.—FIG. 3.



GATEWAY AT ENTRANCE.—FIG. 4.

promoter of the new Act, in order to prevent disappointment, either in the loss to the public of an object so important, or of any remuneration which he (Williams) might be entitled to receive."

Mr. Taylor replied, desiring particulars, but Williams, who began to think that sufficient attention was not likely to be bestowed on the subject at that juncture, did not disclose the details of his project, and so the matter rested till the year 1822. At this time the old London Bridge Water-Works Company were dissolved by Act of Parliament, and the whole of the works destroyed, the supply being assigned to the New River Company, who immediately began to open the streets for the purpose of laying down larger mains. Williams, deploring the evils arising from the streets being torn open, which he said "appeared as though the entire City was preparing for a siege," and considering that the time had arrived for bringing his project before the public, took out a patent, in October of that year, "For a method to prevent the frequent removal of the Pavement and Carriage Paths, for laying down and taking up Pipes, and for other purposes, in Streets, Roads, and Public Ways."

To effect this object, he proposed to construct subways and passages of various descriptions as to capacity, form, situation, and materials, by opening the ground to the required depth—say, of 10 feet—lay a course of bricks, stones, or iron, nearly level, or, rather, curved, on the ground, 5 feet wide, with drains to go into the sewers; raise a wall on each side 5 feet high, and arch it over so as to leave the height in the centre 7½ feet clear; to leave openings of 9 inches in each upright wall, at the distance of every 20 feet, 3 feet from the base; from these openings to carry tunnels to the sides of the streets, and at the end of the tunnels fix gratings or doors to be opened from the inside; to leave similar openings in the top of the arch, at the distance of every 100 feet, for the admission of light and air; and doorways 5 feet high and 3 feet wide, in each side-wall where these openings were made.

The proposed subways might be entered at the sides by doors and passages, wherever required, from the houses and buildings in the streets and roads, in the same manner as into cellars that are under the streets, and the main-pipes for every purpose were to be placed therein, on iron cradles, or otherwise; and the service-pipes for the supply of the public through the tunnels or openings in the side-walls.

The subways might also be formed double, or another parallel to the first—one for water and the other for gas pipes—and in any number that might be required, with or without doors, communicating into each.

From these subways and passages access was to be had into the sewers and drains, or springs and wells of water; and for almost every purpose for which the pavement and carriage paths in streets, roads, and public ways had previously been opened.

With the assistance of Mr. Henry Willey Reveley, a civil engineer, Mr. Williams prepared drawings of the proposed subways, and a committee having been appointed at a public meeting, held at the London Tavern, the "London Subway Company," with a capital of £100,000, in shares of £100 each, was projected. Five miles of subways were first proposed to be laid, at an estimated cost of from £16,000 to £20,000 per mile.

The accompanying engravings exhibit the system of subways as proposed by Williams, being copied from his drawings.

Fig. 1 is a transverse section, showing the roadway and footpath overhead, the method of arranging the gas and water mains, and the channel for the service-pipes.

Fig. 2 is a longitudinal section.

Fig. 3 shows the means by which access was proposed to be obtained to the subway, and

Fig. 4 is a gateway at one of the points of entrance.

The project was a remarkable one, and the drawings illustrating it are not less so, embodying, as they do, to a large extent, the main principles of the more recent and matured designs that have been carried out in practice.

Williams pursued the subject for two years, at his own cost and charge, with all the pertinacity and enthusiasm of an inventor; labouring unceasingly, to the injury of his own regular business, to get his scheme put into actual operation, but without success, till, on the 10th of February, 1825, he offered the patent for sale at Garraway's Coffee House. It does not appear, however, that any purchaser was forthcoming.

Williams, in a volume on the subject, compiled by him, and published in 1828, reiterated his unfaltering confidence in the project. "A remarkable period," he says, "in British history commenced some time after subways came forward. In consequence of the abundance of capital in the kingdom, and the want of adequate employment for it, projects were presented daily, if not hourly, in the City, for both of these purposes. Some of them were highly laudable, and gave activity to thousands, while many, on the contrary, were suggested in fraud, for foreign purposes, and produced great distress and ruin.

"At the period of the sales, numerous endeavours were made, among the brokers and others at the Stock Exchange, to bring forward subways with the view of speculating in the shares; but the object having nothing speculative in it, they could not succeed—not one share ever appeared in the market; none were allowed to be issued, although they were printed and stamped ready for circulation, so that no bubble ever connected itself with this important work,

"The immense quantity of these projects soon overwhelmed subways. They were lost and literally buried under a mass of evanescent matter, which, when cleared away at some future period, after the fever of speculative intoxication shall have subsided, will again appear like a mine of gold, for sober and enlightened construction."

(To be continued.)

CLEVEDON GAS COMPANY.—The annual meeting was held on the 29th ult.—Mr. J. Maynard in the chair. On the motion of the chairman, seconded by Dr. Heard, the following report of the directors was adopted:—"Your directors have much pleasure in presenting a statement of accounts for the year ending March 31, 1877, and recommending the payment of a dividend of £7 per cent., free of income-tax. There has been a considerable increase in the quantity of gas consumed, but, owing to the reduction in price, the returns are somewhat less than last year. On the other hand, the cost of coal for the past year amounts to £987 0s. 8d., as compared with £1100 16s. 10d. for the preceding year. Your directors trust that, as there will be but few extensions or renewals during the coming year, they will be able to meet the present state of depression of trade in Clevedon, and pay the usual dividend." The total receipts for the year amounted to £2878 15s. 3½d., including last year's balance of £26 7s. 6½d., the expenditure being £2011 1s. 5d., leaving a balance of profit of £867 13s. 10½d., of which £840 is dividend at 7 per cent. There is a balance carried to next year's account of £7 3s. 10½d.

Correspondence.

[We do not hold ourselves responsible for the opinions expressed by Correspondents.]

GARDENS IN GAS-WORKS.

Sir,—We ask your indulgence for liberty to make a few remarks on a portion of the extract from the *Hendon Times*, referring to the Child's Hill Gas-Works, which appeared in your last issue. We refer to the editorial comments on the excellence of the fruit, flowers, and vegetables, which have been grown on the premises and in the adjacent gardens. The questions here involved are of great interest to gas companies and managers, since in many localities the existence or non-existence of deleterious fumes, or, as it is generally termed, a "nuisance," proceeding from gas-works, is a matter of contention and expensive litigation between the gas companies and the local authorities. In such cases a powerful argument against the wild accusations frequently levelled by obstructive neighbours against the works, would be the perfection to which vegetables could be raised therein, if the spare ground which is generally to be found in small or medium-sized works were cultivated in an efficient manner. That this is possible we are able to prove, by producing certificates awarded at various horticultural exhibitions for exhibits from our own spare ground; and it would be a good plan for the directors of gas companies, having any facilities of the kind, to encourage their managers to so vindicate the harmless nature of their manufacturing processes, by growing such vegetable productions that their works might become a pride to the neighbourhood, instead of, as in many instances, a blight. It is unnecessary to dwell upon the personal influence which would react in the gardener himself, and probably redound to the advantage of the gas-works through him; but it appears to us that a voluntary arrangement on the part of the directors to recognize the efforts of their *employés* in this direction, by adding a premium to any prizes obtained at any local horticultural exhibition, for articles grown on their own property, would be of very great advantage to all parties concerned.

H. Skoines and Co.

Argyle Street, King's Cross, London, May 30, 1877.

Legal Intelligence.

NOTTINGHAM POLICE COURT.—Friday, May 25.

(Before Mr. Gibson and Alderman Lambert.)

CONVICTION OF THE CORPORATION FOR REFUSING TO SUPPLY GAS.

The Town-Clerk appeared on behalf of the corporation to answer a summons taken out by Messrs. Mitchell and Rodwell, trading as the Nottingham Brewery Company, for refusing to supply gas to a public-house; Mr. M'Craith appeared for the complainants.

The Town-Clerk did no deny the act of the corporation in cutting off the gas, for which he said they had several grounds of defence, which it was not proposed to enter into. The summons was for cutting off the gas attached to the "Three Horseshoes" public-house on the Derby Road, and the persons demanding the supply, Messrs. Mitchell and Rodwell, of Nottingham, common brewers, had taken possession under a bill of sale. He would now shortly state the point in respect to which the decision of the magistrates would be asked for. The custom had prevailed in that town for 30 years, in the case of public-houses, for the incoming tenant to make himself responsible for the gas-rates and taxes left over by the outgoing tenant. Such an arrangement was manifestly convenient for the public, as under other circumstances the corporation would have been compelled, as a protection for themselves, to get security for gas, which, be it understood, they were not compelled to supply without security. It was now attempted, for the first time for 30 years, to break down the custom. This case was brought under section 39 of the Gas-Works Clauses Act, 1871, which provided that "in case any consumer of gas supplied by the undertakers (who were, of course, in this case the corporation) leaves the premises where such gas has been supplied to him without paying the gas-rent or meter-rent due from him, the undertakers shall not be entitled to require from the next tenant the payment of the arrears left unpaid by the former tenant, unless such incoming tenant"—in this case Messrs. Mitchell and Rodwell—"has undertaken with the former tenant to pay or exonerate him for the payment of such arrears." In the present case the question was whether Messrs. Mitchell and Rodwell did make such an agreement with Mr. Stevenson, the outgoing tenant. Upon this point there would be a conflict of testimony.

The Town-Clerk then proceeded to call the following witnesses to prove the agreement Messrs. Rodwell and Co. made with the outgoing tenant, including the payment by them of the liabilities on the house:—

Mr. *Leonard Stevenson* said he formerly kept the "Three Horseshoes," on the Derby Road. On the 15th of May he was bought out by the Nottingham Brewery Company for £100. The arrangement witness came to with Mr. Marriott, clerk to Messrs. Maples and M'Craith, the solicitors engaged for the company, was for £100 and the outstanding gas and other rates, and all claims that the company had against him.

Cross-examined: At Messrs. Maples and M'Craith's office witness agreed to go out of the house for £100, all liabilities against the house to be paid by the company. Witness made the proviso because he wanted to go out of the house "straight," that is, without owing anything.

Re-examined: It was usual for the incoming tenant to make himself responsible for the gas bill and rates incurred by the outgoing tenant. Personally, witness had now no interest in the matter, having filed a petition. If witness had had to pay the outstanding liabilities, very little might have been left of the £100.

Mr. *Henry Barker*, furniture dealer, Bridlesmith Gate, said he was present at the interview between Stevenson and Marriott. The latter distinctly stated that he would see the gas and rates paid. He also observed that the amount for gas was a very large one.

Cross-examined: Witness had traded with Stephenson for several years, who, although "a long-winded 'un," always paid up honourably.

Mr. *John Newton*, warper, of Norfolk Street, gave corroborative evidence as to Mr. Marriott's having said that he would see about the payment of the gas.

Mr. M'Craith said that though the complainants were nominally suing for a penalty, they wished in reality to protect themselves from the claim of the corporation as gas suppliers, which they maintained was unjustifiable. As the Act was only passed in 1871, the question of custom was out of the question altogether. The facts of the case were, that the complainants were very large creditors to Mr. Stephenson, who owed them something like £500, and a few days previous to the date of the interviews deposed to, they took possession under a bill of sale. The goods alone were not very valuable, but, with the licences, would have been worth possibly £300 or £400. The endeavour was made to induce Stephenson to go out on certain terms, and he finally agreed to do so in consideration of the payment of £100, and a receipt for his liabilities to the company. It would be proved that this was the only offer made. Pressure was afterwards put upon Marriott by Stevenson for him to allow some part of the latter's things, forfeited under the bill of sale, to be left out of the bargain, and it was arranged that he should have his bed-room. As it was the complainants were losers to the extent of £200, and it was only worth their while to pay Stevenson what he had asked in order to get him out of the house. It was stated at the interview between Stevenson and Marriott that probably the gas would be cut off, seeing that the bill was outstanding, and Marriott then said, "We shall take care of that." No doubt Barker and Newton did understand from these words that Marriott undertook to pay the gas-rate, but there was no idea of such a thing on his part, and in respect to this matter Stevenson must be deliberately telling an untruth.

Mr. *Marriott*, Messrs. Maples and M'Craith's managing clerk, said that Stevenson agreed with him to go out of the house, and give up everything, for £100. In the afternoon witness further agreed to let him have some bedding out of the house. It was agreed at the interview in the morning that witness should go up in the afternoon to endorse the licences and settle the matter. Witness then learnt from Barker that £12 was owing for gas, and remarked, "We shall take care of that," or something to that effect.

Cross-examined: Arrangements were completed in the morning. Witness never used such words to Barker as would lead him to suppose that the firm meant to pay for the gas.

Mr. *Whittley*, clerk to Messrs. Maples and M'Craith, denied that the agreement with Stevenson included the liabilities against the house. It was made a condition that £100 should be the limit, and the firm engaged to see their clients in order to ascertain what they would give.

The Magistrates, after a short deliberation in private, fined the corporation to the extent of 1s.

Miscellaneous News.

AVERAGE METER SYSTEM IN PADDINGTON.

The following report of the Gas and Water Committee of the Vestry of Paddington has been presented:—

Your committee have much pleasure in submitting for the information of the vestry, the annexed tabular statement, showing the results of the working of the average meter system, for the quarter ending Lady-day last, by which it will be seen that the saving effected in gas for the above-mentioned period has been 1,940,644 cubic feet, representing in money £341 3s. 8d., the amount gained during the corresponding quarter last year was £244.

(Signed) James Flood, Chairman.

Table showing the Hours of Burning and Consumption of Gas for One Lamp during the Quarter ending Lady-Day, 1877, under the Old and New Systems.

Month, 1877.	Old System.		New System.						Gain in Gas over all Lamps.
	Hours Burning per Month.	Estimated Quantity at 5 Cubic Feet per Hour.	Hours Burning per Month.	Estimated Quantity at 5·0 & 4·6 Cubic Feet per Hour.	Gas Saved.				
					Agreed Quantity by Meter Average.	Estimated Consumption per Hour.	By Meter Indication.	Total by Meter and Modified Hours.	
	Hours.	Cu. Ft.	Hours.	Cu. Ft.	Cu. Ft.	Cu. Ft.	Cu. Ft.	Cu. Ft.	Cubic Feet.
January.	478·8	2394	457·75	2240·56	2064·90	4·51	175·66	329·10	571,317·60
February	417·2	2086	361·50	1752·25	1630·33	4·51	121·87	455·62	791,411·94
March ..	369·8	1849	390·08	1881·52	1772·08	4·54	109·44	336·92	586,914·64
Totals.	1265·8	6329	1209·33	5874·33	5467·36	..	406·97	1121·64	1,949,644·18

(Signed) George Weston,
Inspector of Public Lighting.

AVERAGE METER SYSTEM IN ST. PANCRAS.

The Chairman of the Lighting Committee of the Vestry of St. Pancras has just prepared the following report:—

In accordance with annual custom I avail myself of the opportunity of laying before you, in a concise form, a brief record of your labours during the past year, and am glad to say that your efforts to combine economy with efficiency in your department have been successful. The continued success of the average meter system puts beyond further debate the prudence and forethought of the vestry in adopting it, and from the action which has been taken in many towns and parishes, there is further proof, if such were required, that the course pursued by our vestry in adopting this system was the proper one, and one that will be deemed worthy of imitation in many other places.

Now that the system is in full working order, it is unnecessary for me to go into detail as to its operation, more especially as it has recently been given in a report of the second year's working. I may, however, remind the committee that during their year of office they have established a Committee of Observation, whose duty it is to view from time to time the state of the lighting of the parish. This has had a good effect in keeping up the standard of lighting and in showing the men the importance of looking after their lamps both as regards cleaning and lighting. One important alteration in the original arrangements has also been made during the year, by mutual agreement between you and the gas company, and that is that the meters are to be tested *in situ* instead of being removed for testing purposes, and only those are now removed which are known to be out of order. This will not only save considerable expense, but the apparatus will last longer through not being disturbed from time to time as was originally contemplated. You will, remember that when the average meter system was commenced it applied only to the lamps under the Imperial Company, and that the lamps, in the south-western portion of the parish, which were lighted by the Chartered Gas Company were not brought under this system.

Now that the Imperial has been amalgamated with the Chartered Company you have been enabled to arrange with the amalgamated company that the lamps formerly in the Chartered District, and now in the united district, should also come under the operation of the average meter system.

The present arrangement for supervising and controlling details, both as regards the foremen and lamplighters, is working admirably, and is a very marked improvement on the plan at first adopted.

The great improvement which you have effected in the lighting of the Triangle, Great College Street, by the erection of two brilliantly illuminated tri-

partite lamps, has been much appreciated by the residents in the vicinity, and has, I hope, so added to the appearance of the spot that the representatives of the Marquis Camden cannot but feel that the improvement will tend to the interests of their estate

I am sure that the success of our operations will meet the approval of the vestry and of the ratepayers generally, especially when I point to the fact that for the current half year it has only been necessary for the vestry to lay a rate of 1d. in the pound for lighting, whereas heretofore there has never been a rate lower than 1½d. in the pound in any half year. The following table shows the total saving effected during the past year.

Total Saving by the Meter System.

In the cost of gas	£2,868 14 1		
In cost of lighting and extinguishing and in repairs and maintenance of lamps.	304 1 6		
		£3,172 15 7	
Deduct—			
Annual proportion of cost of meters, meter-boxes, governors, cocks, &c., £3226 13s. 9d. .	£320 0 0		
Cost of maintenance of meters, salaries of officers, &c.	583 15 9		
		903 15 9	
Total saving for the year.		£2,268 19 10	

In conclusion, I beg to convey to the deputy-chairman and to the committee generally my thanks for the valuable support I have received as chairman, without which it would have been impossible for me to have passed through the year's work so successfully and pleasantly as I have done.

(Signed) GEORGE MACKANESS, Chairman.

METROPOLIS WATER SUPPLY.

The following are the returns of the Society of Medical Officers of Health, on the composition and quality of the metropolitan waters in May, 1877 :—

NAMES OF WATER COMPANIES.	Total Solid Matter per Gallon.	Oxygen required by Organic Matter, &c.	Nitrogen. — As Nitrates, &c.	Ammonia. Saline.	Ammonia. Organic.	Hardness (Clarke's Scale). Before Boiling.	Hardness (Clarke's Scale). After Boiling.
Thames Water Companies.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
Grand Junction	20·50	0·049	0·135	0·001	0·007	13·2	3·3
West Middlesex	20·20	0·059	0·150	0·000	0·007	13·2	4·2
Southwark and Vauxhall . . .	19·60	0·052	0·150	0·001	0·008	13·2	3·3
Chelsea	20·10	0·052	0·135	0·000	0·007	13·2	3·3
Lambeth	21·00	0·053	0·180	0·000	0·008	13·7	3·7
Other Companies.							
Kent	31·00	0·003	0·420	0·000	0·002	19·4	6·5
New River	19·40	0·036	0·138	0·000	0·006	12·6	3·3
East London	18·80	0·028	0·180	0·000	0·007	11·6	3·3

Note.—The amount of oxygen required to oxidize the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

The water was found to be clear and nearly colourless in all cases but the following, when it was slightly turbid, namely:—Grand Junction, West Middlesex, and Lambeth. C. MEYMOTT TIDY, M.B.

IMPERIAL CONTINENTAL GAS ASSOCIATION.

The Half-Yearly Ordinary Meeting of the Proprietors of this Association was held at the City Terminus Hotel, Cannon Street, London, on Tuesday, May 29th.—JULIAN GOLDSMID, Esq., M.P., in the chair.

The SECRETARY (Mr. Albert F. Jackson) having read the notice convening the meeting, the corporate seal was affixed to the register of proprietors, and the following report was presented :—

The present half-yearly ordinary meeting of the shareholders has been convened, agreeably to the company's Act of Parliament, for the purpose of receiving a report from the president and directors upon the affairs of the association, and for declaring a dividend for the half year ended the 31st of December last.

Gas Made.—The total quantity of gas made at all the stations in the half year ended the 31st of December last was 2614 million cubic feet. The total quantity made in the corresponding half year of 1875 was 2718 million, being a decrease of 104 million, or at the rate of nearly 4 per cent. The diminution arising from the sale of the works at Bordeaux was 154 million, showing, therefore, an increase at the remaining stations of 50 million cubic feet, or 1·84 per cent.

Lights.—The total number of lights at all the stations on the 31st of December last was 1,095,671. The total number of lights on the 31st of December, 1875, was 1,093,371. These figures show an increase of 2300, or at the rate of nearly one-quarter per cent., notwithstanding the loss of 52,560 at Bordeaux.

Mains.—The total length of mains laid up to the 31st of December last was 1077 miles. The total length of mains on the 31st of December, 1875, was 1131 miles, being a decrease of 54 miles. At Bordeaux more than 85 miles were given up.

There is nothing special to report as to the condition of the several stations. They have all been maintained in good repair and working order. Mr. G. W. Drory has, with the assistance of the engineers and agents at the different stations, superintended the conduct of the business, and generally the affairs of the association on the Continent.

The rental for the half year ended the 31st of December last (1876) was less than for the corresponding half year of 1875. The decrease was owing to the association having ceased to light Bordeaux on the 15th of April, 1876.

The profit also was less, though, notwithstanding the loss of Bordeaux, by a small amount only.

The cost of the coal employed during the half year now under review was nearly 2s. per ton less than during the half year ended the 31st of December, 1875.

The value of the secondary products—coke, tar, and ammonia—was 78½ per cent. of the cost of the coal, being an increase of more than 3 per cent. on the corresponding half of 1875.

In the half year now under consideration, large sums were expended at several of the stations—viz., Amsterdam, Brussels, Frankfort-on-the-Maine, Hanover, and Vienna—for the completion of costly purifying apparatus, and for new gasholders.

A considerable outlay was also incurred for mains at nearly all the stations, but more particularly at Berlin, Frankfort-on-the-Maine, Hanover, and Vienna.

Plots of land for the ultimate extension of the works of the association at Hanover, Lille, and Vienna were purchased.

At Brussels, the suit by this association against the town authorities for the balance due from them on payment of the works sold, was still before the court, and remained undecided.

On the 5th of December last a new contract was concluded for lighting one of the suburbs of Brussels—namely, the "Commune" of Forest.

At Hanover, on the 21st of September last, a further contract for lighting the suburb of Linden (containing some modifications of the then existing contract) was signed with the authorities of that suburb.

At Vienna, on the 30th of last November, a contract was concluded for lighting the small suburb of Floridsdorf.

The president and directors desire now, in conclusion, to draw the attention of the shareholders to the accounts for the half year ended the 31st of December last.

These have been duly audited, and from them the directors have, in accordance with the provisions of the Companies Clauses Consolidation Act, prepared a scheme showing the profits of the association for the last half year, and the portion thereof applicable to the purposes of dividend, which the president and directors recommend now to be declared—namely, a dividend of £2 and a bonus of 15s. per share, payable, free of income-tax, on and after the 15th day of June next.

The directors who go out of office by rotation are Julian Goldsmid, Esq., M.P., N. Montefiore, Esq., and Francis Bassett, Esq. The auditor who goes out of office is Joseph Sebag, Esq. These gentlemen are all eligible for re-election, and offer themselves accordingly.

The CHAIRMAN: Gentlemen, the report which you have just heard gives you the usual information with regard to the affairs of the association during the half year ending on the 31st of December, 1876, and I think you will be of opinion with the board that, under the circumstances, it is a report which is most satisfactory, both to us, as managers of this undertaking, and to you, as shareholders in it; because, notwithstanding that we have sold one of our important stations—Bordeaux—and therefore the accounts for the half year we are now considering have to be compared with the corresponding half year, which included the business done in that town, we have still very nearly the same amount of profit that we had at that period, and we are able to declare again the very highest dividend and bonus ever paid to the shareholders of this association. Now, you will ask, no doubt, what is the reason of this? One reason is, of course, a very obvious and simple one—that is, that our business has been increasing very largely at other stations. We are spending very large sums of money upon some of those stations, and we find it is absolutely necessary that we should do so. Every one who is acquainted with an important capital like Vienna must know that the extensions which take place yearly are very large. If he will compare, for instance, the additions which are yearly made to any of the suburbs of London, he will be able to judge how rapidly a capital increases itself, and as we light several capitals, we have to spend large sums of money constantly in providing for that purpose. Sometimes we spend £120,000 or £130,000 a year to meet the legitimate enlargements of our business, which legitimate enlargements ultimately lead to increase of profits. But there is also the much more important reason, namely, that coals have been unusually cheap. I mentioned last year that on several occasions we had been told that the cost of coal did not affect us. The fallacy of that statement has been abundantly proved by more than one gas company. The fact that we have been able to maintain our profits at the same amount, notwithstanding the loss of a considerable station, is owing to the great extensions of our business generally, and to the decrease which has taken place in the cost of coal. We are paying to-day 2s. per ton less than we were paying for the corresponding period of last year, and I do not see at present any prospect of a serious increase in price for some time to come. I think, therefore, in this respect we may congratulate ourselves as to the prospects of our undertaking. The president of the association, Sir M. Montefiore, has written to me to say that he regrets his absence from the meeting on this occasion, and that he entirely concurs in the views of the board with reference to the present position of our affairs. The next matter to which I would allude is one that has been discussed on more than one occasion, and it is one respecting which all of us—shareholders and directors alike—are anxious; I mean the proposed writing off of the £6 15s. unpaid on the shares of the association. We have already informed you that we have consulted some of the most eminent counsel, and we have gone into the matter thoroughly and conscientiously; but the result of the advice we have taken is that it is entirely out of our power to write off this amount without the authority of an Act of Parliament. We find that if we did so we should be exceeding those limits which the most experienced lawyers say we have no right to exceed, and that we should render ourselves liable to proceedings in Chancery on the part of trustees whose rights would be to some extent affected thereby. We do not, therefore, recommend that any course of that kind should be adopted. Still we see there would be very great advantage if the thing could be done, and we are at the present time in consultation with our solicitor, who is carefully preparing the heads of an Act which we shall endeavour to obtain in the next session. Our solicitor will lay this before us in due course, and we shall then ask for your approval if necessary. But I think the shareholders will agree with the board in the opinion that we should endeavour in this Act to settle several other points which may arise, and may be of importance to us hereafter, and this we propose to do. I think, too, you will be of opinion with the directors that we should endeavour to obtain that Act to leave us to manage our own affairs, for we practically are the only people affected by them. The Legislature is not required in our case to look after the interests of any consumers; the municipalities or other local authorities in every town we light do that; and therefore all the Legislature has to do is to see that we do not exceed those proper limits which ought to control every board of directors in the management of a company such as this is. Now, gentlemen, I have pointed out to you on more than one occasion that as our affairs are growing in importance, personal supervision becomes exceedingly difficult. None of your directors have hesitated, when required, to go to the Continent and look after the interests of the association on the spot, and during the past year it was thought that a personal inspection should take place with regard to three stations in Holland. Under those circumstances, Mr. Wood and Mr. Palmer kindly went over to that country and gave us the benefit of their inspection of our works. But there is one portion of our business which no director could investigate. We used formerly to leave to Mr. Drory the personal supervision of the accounts of the individual stations, but Mr. Drory is now labouring under a disability which affects all of us in turn, and generally at a time when we least like to experience it, and that is old age. Mr. Drory is—well, I need not say how many years past 70, and he finds it is not now so easy a matter to move about in the way he formerly did. Under these circumstances, and, considering the very large business which we are now carrying on in the very important towns of Vienna, Berlin, Antwerp, Frankfort, and so on, we have thought it desirable to have a perfectly independent and extraneous investigation of the accounts of these stations, which are always locally looked after, but have not hitherto been looked over from London, except through the medium of Mr. Drory, as manager on the Continent. We have, therefore, on the strongest recommendations we could have, appointed a gentleman for one year, just to see how the thing will work, whose duty it will be to inspect, on the spot, the accounts of the several stations. That gentleman is Mr. Wingfield, and we have every reason to believe he will prove to be a very valuable servant of the association. Well, now, gentlemen, these, I think, are the points of the greatest importance in your affairs which it is my duty to bring before you. But, before closing, I would make one remark with regard to Bordeaux. You will remember that, on more than one occasion, you have been told, both by Mr. Twells and by myself, what difficulties we had to deal with at Bordeaux. First of all, we had more or less to fight the municipality; then we had to fight the company which ultimately obtained the new concession—a concession which we did not consider at all likely to prove profitable, and were, therefore, unable to take. We are in hope now that nearly all the questions pending between us have been practically settled, and, when that is done with, I think we shall have no more trouble about Bordeaux, as the money for the purchase of the property, as you know, has been paid. But now we do not get the profit of lighting Bordeaux. One thing I am certain of. From all I hear, it is not lighted in the same satisfactory manner as when we were the contractors

for doing it. I believe that in no case, in which we have either sold our property to another company or to the local authority, has the lighting of a town been improved by the change. This proves, of course, satisfactorily that our work was done as well as it was possible to do it; I do not want you, however, to look with equanimity on this state of things. Having lost Marseilles and Toulouse, and sold Cologne and Bordeaux, we are reduced by four important stations, and although the increased business at our other stations nearly covers the loss thus experienced, we cannot go on upon that principle. We have been endeavouring, in the new contracts made in the last few years (and in the last few months we have had examples) to give every reasonable concession to the local authorities, in order that we may carry on business for as many years as possible in the towns we undertake to light. We are anxious to remain a gas company, and not to realize our property. We endeavour to light well the towns we light, while we look after our own interest, and pay a substantial dividend. I think under all the circumstances you will agree with me that the report you have heard to-day is very satisfactory, and that I am justified in moving that it be adopted and entered on the minutes.

Mr. JOHN RICHARDSON seconded the motion.

Mr. PRICE, referring to the remarks made by the chairman as to the appointment of Mr. Wingfield, asked whether that gentleman had been accustomed to gas manufacture, or whether he was a novice in the business. On another point mentioned, the writing up of the £6 15s. on the shares of the company, he was not presumptuous enough to question the opinion of a Queen's counsel, but it seemed to him rather contrary to ordinary notions of business that the company were not able to call up their own property in any way they pleased. However, as the board were going for an Act of Parliament to decide the point, he was content to wait, and felt it was quite right to have the matter made perfectly clear. With regard to the profits of the last six months as compared with the half year ending Dec. 31, 1875, he asked for an explanation. The difference in the amount was only about £4000, notwithstanding the loss of the Bordeaux works. In the last half year was the amount set apart as profit the real earnings of the period, or were there other items included of any kind? Of course there were the dividends on the very large investments held by the association in both half years, but there might also be some items in the last statement which did not appear in the former. He regretted to hear that Mr. Drory was beginning to feel the infirmities of age. The association were indebted to that gentleman for very much of the success which had characterized their operations for many years, and they owed him a debt of gratitude for his services. With regard to the reserve-fund the directors had now brought it up to nearly £200,000, and he would like to know what additions would yet be made to it and how far the shareholders were off from getting a larger dividend than they had yet obtained. On the last occasion they were told that the period had not then arrived; another six months had rolled away, and he thought they were past it. He did not care to lay up so much for those who would come after them, and thought they ought to have a little of the money in their own pockets. No doubt the investments of the association were in good stocks, but it was not their business to be a trust company. All they should aim at in this way was to be sure that they had a sufficient sum of money laid by for the purpose of meeting contingencies. He thought they had already more than enough. Again, he took exception to the proposition to pay £2 per share dividend and 15s. bonus. Why not call it all dividend? He thought an improvement had been introduced by the directors in announcing the rate of dividend in advance, and not leaving it to be disclosed at the meeting. It closed the door against the possibility of prior information being made use of, as it had been in this company. He congratulated the directors on this new movement; they had now got upon the incline, and perhaps would soon give the shareholders something more. With reference to the proposed application to Parliament, he hoped the board would endeavour to cover as much ground as possible, and that in their proceedings they would be guided and advised by some parliamentary agent who was in the habit of having gas companies Bills in his hands. There was always some technical information to be had from such agents which was not otherwise attainable. Referring to Vienna, did he understand that the directors had made a fresh contract for the suburbs, as they had done in some other towns?

The CHAIRMAN said they had been making such contracts gradually. The directors, some four or five months ago, discussed the question of announcing the dividend before the meetings of shareholders, as was done in the case of the great railways, and came to the conclusion it was a desirable course to adopt. They were glad that it met with the approval of the proprietors, and they would continue to follow that course in the future. With regard to the appointment of Mr. Wingfield, he did not desire, nor would it be fair to that gentleman, at this meeting to go into the recommendations upon which he was appointed. The board were quite satisfied that in appointing Mr. Wingfield they had appointed an honourable and conscientious gentleman, who, they believed, was eminently qualified for the discharge of the duties he would have to fulfil. As already remarked, the arrangement was for one year only, and was so made that each side might be free to act if it was not satisfactory; and that if at the end of the time it was not mutually agreeable, they could part without bitterness. He hoped, however, that Mr. Wingfield and the association would remain in connexion for many years. As to the proposed application to Parliament, Mr. Price might be assured that the directors would not do anything in too great a hurry, and that what they did would be maturely considered. As they had the good fortune to have two or three members of Parliament on the board who had had experience in gas matters, the shareholders need not be afraid that the best course would not be adopted. The directors would endeavour to make the Act as comprehensive as possible, so as to meet the future requirements of the association. With reference to the inquiry as to Vienna, the shareholders were aware that in many of these large towns the Municipality covered only what might be called the town proper, and that there were important suburbs requiring to be lighted, with which the association were able to make arrangements. This had been the case at Vienna, as was stated in the report just read; and since then several other suburbs had followed suit. The directors, in the contracts thus made, gave to the districts every advantage they possibly could, while at the same time they endeavoured to do the best for their shareholders. Referring to the reserve-fund, Mr. Price would remember that one member of the board—Mr. Bassett—when he sat on the other side of the table, made some excellent speeches in favour of increasing the dividends, but he also spoke strongly in favour of having a good substantial reserve-fund, which could not be touched without the sanction of the shareholders. When asked at one time how far he would go in this direction, Mr. Bassett said he thought it ought to amount to a quarter of a million. That view had been concurred in by the board, looking at the fact that their property was not freehold, but only leasehold, which might terminate at the end of their concession, or which, if continued, could only be renewed by making considerable changes. He believed that if the shareholders looked at the matter from the same point of view, they would fully agree with the directors. The only other inquiry made by Mr. Price was with regard to the profits; and, in reply, he would say that there had been no alterations in the accounts in that respect, and nothing had been included in the last half year which was not included ten years ago.

Mr. PRICE said his inquiry was whether the difference of £4000 was to be accounted for by the loss of Bordeaux.

The CHAIRMAN said if the honourable proprietor had listened to the report he would have heard that the difference in profits by the loss of Bordeaux was much more than £4000, but that the increase at other stations had reduced the larger amount to the sum of about £4000.

The motion for the adoption of the report was then put and carried.

The CHAIRMAN moved, and Mr. TWELLS seconded, the following resolution, which was also adopted:—"That a dividend of £2 per share, and a bonus of 15s. per share, be declared upon the 56,000 shares of the association for the half year ended the 31st of December last, and that the said dividend and bonus be payable, free of income-tax, on and after the 15th of June next."

Mr. TWELLS: Gentlemen, you have heard by the report that several directors go out of office on this occasion, and the first of these is our excellent friend and chairman, Mr. Julian Goldsmid. I think a motion for his re-election would come better from this side of the table, because we, the directors, are not only anxious to have an efficient chairman for the management of the company, but also a gentleman who, by his social influence, courtesy of manner, and general aptitude, is entitled to the cordial co-operation of the other directors. I have, therefore, much pleasure in moving the re-election of Mr. Goldsmid.

Mr. HADEN seconded the motion, which was cordially adopted.

The CHAIRMAN acknowledged the compliment thus paid to him, and moved the re-election of his colleagues, Mr. Montefiore and Mr. Bassett.

Mr. HELME seconded the motion, which was carried unanimously.

On the motion of Mr. PRICE, the retiring auditor, Mr. Sebag, was re-elected, and that gentleman returned thanks.

The CHAIRMAN moved, Mr. PRICE seconded, and it was resolved that a vote of thanks be given to Mr. G. W. Drory, the general superintendent of the affairs of the association on the Continent, and to the agents, engineers, and other officers of the association.

Mr. HADEN moved, and Mr. RICHARDSON seconded—"That the cordial thanks of the meeting be given to the president and directors for their able management of the affairs of the association, and to the chairman for his conduct in the chair this day."

The motion was put and carried unanimously, and

The CHAIRMAN having acknowledged the vote, the proceedings terminated.

CARLISLE CORPORATION GAS-WORKS.

The *Carlisle Patriot* of the 18th ult. furnishes its readers with the following interesting particulars respecting these works:—

Amongst the many improvements now going on in this city to meet the growing demands of the time, few are of more importance than the extension of the gas-works on the present premises, and the initiatory steps now being taken for the establishment of new works on Boustead's Grassing. When the corporation acquired the then gas-works, in 1848, the present site was considered sufficient for any enlargement that would likely be made. Of late years, however, the ever-increasing demand upon the Gas and Water Committee not only rendered it necessary to utilize to the best advantage every inch of the ground at present in their hands, but they were also compelled to look around for a site on which to erect manufacturing apparatus adequate for the inevitable requirements of the future. The following is a summary of some particulars showing the growth of the works from 1855:—

Date.	Loans on Mortgage.	Gross Capital Expended on Works.	Revenue from Gas Sold.	Net Profits.
1855	£18,227	—	£6,805 13 9	£1,242 4 11
1860	17,262	£36,798 13 2	8,993 8 5	2,774 5 5
1865	13,698	42,065 19 6	8,925 11 10	2,316 10 4
1866	12,279	42,742 19 9	9,193 17 9	2,018 19 5
1867	12,279	44,343 11 3	9,424 18 7	2,400 13 11
1868	12,279	44,861 16 0	10,192 4 10	2,015 13 8
1869	12,279	47,333 5 0	10,802 10 1	2,724 2 9
1870	12,107	52,406 6 3	10,599 9 11	2,531 18 3
1871	11,720	53,047 0 5	10,707 16 7	4,181 16 5
1872	11,505	54,234 16 9	12,072 9 0	4,750 10 6
1873	11,505	57,074 13 9	14,200 4 6	3,072 9 10*
1874	11,505	57,404 1 8	15,056 9 1	2,924 15 6*
1875	10,989	58,557 13 3	14,039 18 11	3,305 18 7
1876	10,000	60,786 10 6	15,468 6 4	5,401 4 7

* Great advance in price of coal.

In 1855–6 the price of gas was 4s. 2d. per 1000 cubic feet; in 1865 it was reduced to 3s., and remained at that figure until coal became so dear in 1873, when an additional 6d. per 1000 was charged for that and the following year. In 1875 the price was again reduced to 3s., and it remains at that figure at the present time.

Two years ago Mr. Hepworth, the able and courteous engineer and manager, drew attention to the necessity for the immediate and considerable extension of the works; he pointed out that the growing demand taxed to the utmost several parts of the apparatus employed, and that, in some respects, the ground would not admit of further material extension, though, with certain additions and continued care in the management, provision could be made for procuring the estimated consumption of gas for a few years. He calculates that the consumption of gas in Carlisle is doubled every 13 or 14 years. After much deliberation, the corporation agreed to carry out certain extensions which would lighten the necessary darkness until new works were constructed further up the banks of the river Caldew. Under the active superintendence of Mr. Hepworth, the alterations are now being carried out with vigour. A condenser, capable of condensing 750,000 cubic feet daily, was brought into use in October last. It cost about £700, and stands at the top or north end of the works. Last month, the committee have come into possession of a part of Nelson's yard, about 1000 yards in extent, upon which a new retort-house, sheds for additional coal storeage, and other convenient housing will be erected. The foundation of a new retort-house has just been commenced. It will contain six ovens of through retorts capable of manufacturing 300,000 cubic feet of gas per day, and will cost about £500. A new washer is nearly completed; it will cost about £100. A new scrubber was finished in March last and another is being enlarged. The estimated cost of this work is about £850. Messrs. Hill and Beaty, builders, are now busy with the erection of a chimney at the end of the retort-house, the contract for which is £450. The manager hopes to see it completed by the end of June. It will be 120 feet high, and 5 feet 6 inches internal diameter. The existing or old chimney, standing in the centre of the viaduct, has not been used for several weeks, and will soon be removed—from an æsthetical point of view, the sooner the better. The house and offices adjoining the works having been very much darkened by the construction of the viaduct, considerable alterations are now being carried out there. On the ground floor a large store-room and residence for the foreman is being fitted up; the first floor is being converted into a suite of offices, including committee-room, manager's offices, general office, and show-room for fittings. There will be an entrance to the offices from the viaduct, and a flight of steps exists for access from the main thoroughfare to the works. Lately several

new mains have been laid from the works to some of the principal streets in the city, to the viaduct approaches, to the west side of the Caldew, to the new streets near to Fusehill Workhouse, to London Road, as far as Upperby, and to other places in the vicinity, which are becoming thickly populated. With the erection of a gasholder at the site of the new works, it is conjectured that the present manufacturing power will be sufficient for a year or two.

As already stated, the new works are to be erected on Boustead's Grassing, where some ten acres have been set apart by the corporation for this object. Many years, however, may elapse before the general scheme is fully developed. For the present, a large holder, 125 feet in diameter, will be constructed there, and it will be connected with the works by a large trunk main, which is now in progress of construction. Excavations are being made for a trial well preparatory to erecting this holder, and it is questionable if it will be ready for use before the spring of next year. The site lies immediately behind the works of Messrs. Lowthian and Fairlie, over the new bridge. We have seen the plan of the general scheme. Crossing the bridge, there is a portion of what is known as Heysham's field on the left, upon which and a portion of the Grassing it is intended to erect six holders, averaging 125 feet each in diameter. The offices, foreman's residence, and store-rooms will be placed on the ground adjoining the new road at the bridge; behind this group of buildings will be a row of sheds for storeage purposes, and in rear of these, and adjoining the Maryport and Carlisle Railway Company's line, there will be a purifying-house, scrubbers, condensers, &c. Further up the Grassing a retort-house, engines, exhausters, boilers, pumps, and other apparatus will be fixed. At the high end of the works large tanks will be constructed. The plan also shows that lines from the Maryport and Carlisle Railway Company's line will connect the works with the main line; they will be used for bringing in coal, pipes, &c. The new street will be carried onward in continuation from the bridge. On the right side of the ground, adjoining the river, the space will be utilized for storeage and other purposes. Many years will be required to complete the scheme. Matters of detail, which, in some instances, may yet result in a re-arrangement of sections of the work, will be duly considered as the exigencies of the time demand. The whole of the work now going on is being superintended by Mr. Hepworth, who has also drawn out the various plans, and for a considerable time to come his hands will be pretty well filled.

EXETER GAS SUPPLY.

At the Meeting of the Exeter Town Council, on Wednesday, the 23rd ult.—the MAYOR (Mr. W. Cuthbertson) presiding,

A letter from the gas company was read, in reply to a communication from the council on the 11th of May, and in reference to a resolution passed at a meeting of the council on the 5th ult. The directors refused to admit that the nuisance complained of arose at their works, still, for the information of the council, they stated that a staff of men had been engaged for more than a month past in carrying out alterations and improvements, also that additional apparatus would be fixed as early as practicable, with the greatest care, so as to avoid the possibility of a nuisance arising therefrom.

Mr. WARE asked if the committee of the council were empowered to conclude the purchase of the gas-works.

The TOWN-CLERK replied that the terms of purchase were pretty well agreed on, and the committee had to learn whether the company would accept those terms.

At a subsequent part of the meeting in reference to the instruction given him to inquire as to whether there was evidence procurable to sustain a prosecution against the gas company, the TOWN-CLERK reported that he had collected certain evidence which was of a very direct character, and perhaps the council would now refer the matter to some committee to conduct the prosecution.

Mr. WILCOCKS said he should like to know whether the town-clerk was going to proceed with the prosecution of the company.

The TOWN-CLERK replied that the council could not help themselves.

Mr. WILCOCKS said that although the council could not help themselves, and must prosecute the gas company, still he could not allow the prosecution to proceed without entering his formal protest against it. He might say the "gas nuisance" had never affected him, either directly or indirectly, and he very much doubted whether all the stenches that had been recently smelt had arisen from the gas-works. Whilst he did not wish to put himself forward as a champion of the gas company, and though he considered they had unwittingly been much to blame, still he liked fairness, and when he saw them trying to put their works into a state which would comply with the recommendations of the eminent man brought down by the council, he thought it was not right to prosecute them. The council had been charged with not doing their duty in this matter, but he maintained that the council had done everything they possibly could to have the nuisance abated. The council had tried, and were trying now, to purchase the gas-works, and just as they were coming to terms with the gas company they had notice served upon them to prosecute the company for an alleged nuisance. He repeated again that he considered the notice to be mischievous and malicious, and not only that, but the charge against the council, of not doing their best, was a piece of infamous calumny. From what he had been able to see in the papers lately, it appeared to him that there were some people who did not wish the council to buy the gas-works. The only reason he could see for that was that those persons would have nothing further to agitate for if the gas-works were purchased. ("There's the water question.") Their stock-in-trade would have vanished. The words of Dr. Watts's hymn, that

> "Satan finds some mischief still
> For idle hands to do,"

had occurred to him as appropriate to the authors of that statutory notice. He had asked himself, what was all this agitation against the gas-works for? Was it for a certain individual, or number of individuals, to gain a cheap notoriety? Or was there something to be done to try and divert the attention of the citizens from anything else—as Mr. Hirtzel suggested, from the water company? He protested against the course.

Mr. F. THOMAS did not think that all the persons who signed the statutory notice were actuated by the feelings Mr. Wilcocks imagined. While the gas company were doing all they could do, the council would be prepared to do their duty. He was quite aware they would have the same equally disagreeable duty to do with regard to the water company, and if Mr. Wilcocks hinted that they were likely to overlook that one, he was very much mistaken. He should like to know if the committee who were empowered to treat with the gas company had the slightest power to commit the council.

The TOWN-CLERK: They have no power. It is with this body to conclude the negotiations or not.

Mr. COURTNEY certainly thought the council ought to stay their hands before running into such an expense as that involved in the contemplated prosecution.

Alderman CLIFFORD entirely agreed with Mr. Wilcocks. But the council were in this position—they were compelled to act, and, therefore, the matter had much better go before the Sanitary Committee. He accordingly moved that the question be referred to that committee.

Mr. HIRTZEL seconded.

Mr. NORRINGTON asked if the council were aware of what the gas company were doing. The moment the council saw a serious attempt was being made to remove the evils complained of, the memorialists came upon them to prosecute the company. To prosecute at the present time looked to him as a quite unnecessary act. He only hoped that what the memorialists had done, they had done in ignorance.

Mr. JONES said if Mr. Norrington would put himself in communication with some of those gentlemen who had signed the statutory notice, he would find that their object was to prevent the purchase of the gas-works.

Mr. WILLEY said there was an impression abroad that the council were obliged to purchase the gas-works at a maximum of 10 per cent. That was not so, because there was a large quantity of the property that did not pay 10 per cent., and, therefore, he thought the purchase would rather be at the rate of 7½ per cent. He agreed with Mr. Norrington that this was an unfortunate time for the prosecution. He had lately been at the works, and endeavoured to make himself acquainted with the subject, and he believed that the company were trying to do all they could to bring their works into good order.

The motion referring the matter to the Sanitary Committee was then carried.

BAHIA GAS COMPANY, LIMITED.

The Ordinary Half-Yearly General Meeting of this Company was held at the London Offices on Tuesday, the 29th ult.—EDWARD HORNER, Esq., in the chair.

The SECRETARY (Mr. A. J. Head) read the advertisement convening the meeting, and the following report and statement of accounts were presented:—

The directors herewith present the audited statement of accounts for the half year ending Dec. 31, 1876.

The mains for the first two sections of the new system have arrived at Bahia, and are now being laid. Those required to complete the system will be sent out as soon as the manager is prepared to lay them. Considerable progress has been made in the reconstruction of the works.

The profits for the half year, £3919 7s. 8d., added to the balance brought forward, makes the sum of £4360 19s. 11d.; out of which the directors recommend the sum of £500 to be carried to the reserve-fund, and the payment of the preference dividends of 10 and 7½ per cent. respectively for the half year, and that a dividend of 3 per cent. per annum be paid on the ordinary shares. This will absorb £4125, leaving £235 19s. 11d. to be carried forward.

Dr. *Balance-Sheet, Dec. 31, 1876.* *Cr.*

Capital—				Concession	£7,000 0 0
5000 ordinary shares	£100,000 0 0			Investment to June 30, 1876	95,941 13 9
1000 10 per ct. preference shares	20,000 0 0			Additional during half year	1,410 18 6
1500 7½ ditto ditto	30,000 0 0			Freehold land	4,705 2 7
Creditors—				Meters fixed	3,014 6 9
On open accounts	947 15 9			Office furniture and fixtures at Bahia and in London	400 17 8
On acceptances	5,014 11 6			Preliminary expenses	16,914 17 3
Dividends unpaid	36 10 2			Suspense account—	
Insurance-fund	47 4 10			Extension of retort-house, &c.	2,114 4 11
Reserve-fund	2,000 0 0			Mains renewal	488 3 9
Profit and loss	4,360 19 11			Plant	589 9 11
				Amounts due for gas, fittings, &c.—	
				Public lamps	1,580 18 4
				Ditto establishments	4,067 15 11
				Private rental, fittings, and coke	5,517 18 7
				Sundry debtors	66 11 4
				Stock—	
				Coals	3,065 8 9
				Coke	223 4 0
				Fittings	3,961 16 3
				Mains, lamp-columns, and other materials	2,430 4 2
				Goods in transit	3,854 16 7
				Bills receivable	3,500 0 0
				Cash at bankers—	
				General account	431 5 0
				Dividend account	36 10 2
				Bahia	763 8 1
				London office	11 12 6
				Bahia office	335 18 2
	£162,407 2 2				£162,407 2 2

Revenue Account.

Coals carbonized	£6,550 2 10	Gas supplied to public lamps	£9,523 2 11
Purifying materials and wages	331 16 0	Less fines	221 16 7
Carbonizing wages	1,327 3 6		£9,301 6 4
Wages, yardmen, &c.	269 12 9	Private consumers	6,707 7 7
Repairs, mains, and services	369 19 0	Public establishments	1,465 8 6
Lighting and repairing of public lamps	1,412 12 8	Meter-rental	531 3 10
Salaries	1,821 16 11	Products £1,947 14 5	
Directors fees	400 0 0	Less labour 95 13 10	
Auditors fees	21 0 0		1,852 0 7
Rent and taxes	113 1 6	Transfer fees	2 12 6
Interest	47 6 2	Profit on fittings	241 10 1
Stationery	43 4 2	Bad debts recovered	21 2 0
Office expenses	33 11 5		
Trade charges	193 12 11		
Travelling expenses	54 13 2		
Wear and tear	1,144 6 11		
Bad debts and allowances	458 1 6		
Exchange (loss)	187 9 11		
Law charges	42 10 11		
Extraordinary disbursements—			
Extension of retort-house, &c.—			
One-sixth of £3951 11s. 5d. (5th instalment)	658 11 11		
One-sixth of £1078 19s. 6d. (4th instalment)	179 16 7		
One-sixth of £1274 16s. 3d. (3rd instalment)	212 9 5		
One-sixth of £687 17s. 9d. (2nd instalment)	114 12 11		
Renewal of mains—			
One-sixth of £585 16s. 5d. (1st instalment)	97 12 8		
Renewal of plant—			
One-sixth of £707 7s. 11d. (1st instalment)	117 18 0		
Balance—profit	3,919 7 8		
	£20,122 11 5		£20,122 11 5

Profit and Loss Account.

Dividend declared Nov. 14, 1876	£3,625 0 0	Balance of account to June 30, 1876	£5,066 12 3
Reserve-fund	1,000 0 0	Revenue account, net profit for the half year ending Dec. 31	3,919 7 8
Balance	4,360 19 11		£8,985 19 11
	£8,985 19 11	Balance brought down	£4,360 19 11

The CHAIRMAN moved the adoption of the report. In doing so he said on looking over the accounts the shareholders would perceive that the profits made during the last half year, as compared with those of the corresponding period of 1875, were somewhat better, although not quite equal to those of the half year ending June last. Whether that arose from the circumstance of the badness of trade or otherwise, he could not tell; probably the great bulk of the inhabitants of Bahia were now supplied with fittings for gas. There was a falling off in the receipts on that account, and the profits were less by £284, but on the other side of the account there was a decrease in the charges for renewal of plant and mains of £351. The cost of coal was something like £167 less this half year, although the quantity carbonized was the same; but probably the result obtained from the coal had not been quite so good. The leakage continued to be exceedingly unsatisfactory, and such as in an English town would be regarded as very serious. The directors were in hope that they had in some measure discovered a part, at all events, of the cause of it; for in laying down a new main lately it was found that the mains laid down many years ago were in a perfectly decayed state, so that the amount of leakage must have been of very large extent. Indeed, great as the cost of relaying the mains in the town would be, it would have this advantage, that it would lead to a thorough overhauling of the services, and the detection and remedying of faulty connexions. Another cause for the large amount of unaccounted-for gas was the excessive consumption of some of the public lamps. As soon as they were able to do so, the directors intended to adopt governors to these lamps, and thus remove another unsatisfactory element in the present working, for if the leakage could only be reduced to a moderate amount, it would make an enormous difference in the profits of the company, because then much less coal would be required, less purifying material, and, in fact, everything would be reduced in proportion. It was fortunate, therefore, that they had something to look forward to as a means of improving the condition of the undertaking. Still, looking at the accounts as a whole, he thought it was gratifying to observe that there was a considerable improvement upon the previous year. The quantity of gas produced per ton of coal was very fair, and but for the leakage from the services, and excessive consumption of the public lamps, which ought not to exist, they might congratulate themselves generally upon the state of affairs. Some new mains had been laid in the half year, and the directors had sent out mains to the value of £3000, and probably before those mains were laid the cost would be something like £6000. But as, of course, those mains were greatly in excess of the mains before laid, they would only partially become a charge upon the revenue. It was to be hoped that in Bahia, as elsewhere, the laying of larger mains would be found a source of considerable profit to the company. In this matter, therefore, he thought the prospects for the future were not bad. The most difficult question for the directors to deal with was the money question. All the capital was called up, and the board had nothing to fall back upon for the necessary outlay involved in such operations as main-laying. This, to a certain extent, did not embarrass them, for they had plenty of assets, but still they were not in so pleasant a position as if they had more capital to call up to pay for these extensions. However, if they got these pipes properly laid, he had no doubt they would find an immense advantage from them. He did not know that he had much further to state, except to mention that the directors had been able still further to reduce their expenses at Bahia, for which he thought the manager out there deserved considerable credit. The rental had not increased very much, the public lighting in the half year was only £314 more, but then the fines had been largely reduced. Instead of being £1300 or £1400, as they once were, they were now only £221. which in itself showed that, notwithstanding the difficulties under which he laboured from the state of the mains, the engineer was doing his best to improve the condition of affairs. He (the chairman) was very much in hope that when the larger mains were completed the item of £221 would almost entirely disappear. As he had before remarked, the private consumption remained much about the same; there was a little deficiency, about £70, but probably that could be accounted for if the manager was present. The total result of the half year's working was that the revenue had increased by £250, in what was, after all, the best period of the year. With these remarks he moved the adoption of the report.

Mr. H. BROTHERS seconded the motion.

Mr. WILSON asked whether in the next account they might expect to see a better result from economy in the cost of coal.

The CHAIRMAN said that probably it might be so, but somehow or other during the last six months the cost of coal per ton was exactly the same as before. The amount in money was £167 less than for the corresponding period of 1875, but there had been more coal used. He did not think they would obtain coal much cheaper, for freights had been very low. In fact, latterly the company had had to pay a little more.

The motion was put and carried.

The CHAIRMAN moved—"That a dividend for the half year ending Dec. 31, 1876, at the rate of 10 per cent. on the 10 per cent. preference shares, at the rate of 7 per cent. on the 7 per cent. shares, and at the rate of 3 per cent. on the ordinary capital of the company, less income-tax, be and is hereby declared." In making this motion he ought to state that at the present moment the directors were not in funds to pay the dividend, but they were expecting remittances, and in the course of a month they hoped to be able to send out the warrants.

Mr. MAGNUS OHREN seconded the motion, which was put and carried.

Mr. H. P. STEPHENSON moved a vote of thanks to the directors for the admirable manner in which they had managed the concern, and in doing so expressed his satisfaction at seeing the chairman present in an improved state of health.

Mr. R. KING seconded the motion, which was cordially adopted.

The CHAIRMAN acknowledged the vote, and the proceedings terminated.

STAFFORDSHIRE POTTERIES WATER-WORKS COMPANY.

The Thirty-first Annual Meeting was held at the Company's Office, in Hanley, on the 30th ult.—Mr. J. ALCOCK in the chair.

The following report of the directors was presented:—

In submitting to you the annual statement of accounts, made up to March 25, 1877, duly examined and certified by the auditors, your directors have to report an increased rental for the year ending March 25, 1877, exceeding that of the previous year by the sum of £1006 18s. 11d. The balance for the year ending the 25th of March last, and the previous undivided balance of £2706 4s. 5d., make a total of £6211, out of which your directors recommend that a dividend be declared at the rate of 6 per cent. per annum, clear of income-tax, and payable by dividend warrants, to be forwarded to the shareholders on the 25th day of June next. This will absorb the sum of £5460, leaving (after placing a further sum of £1000 to the reserve-fund account, which will then amount with interest to £3553 4s. 2d.) a surplus of £751 to be carried to next year's account.

The operations in connexion with the Cheddleton Park works have not been resumed during the past year, and a portion of the temporary plant has been removed and used for carrying on the sinking operations at the Meir works. The extension at present being carried on at the Meir comprises pumping water from the existing 24-inch bore-hole, and the sinking of a shaft 10 feet diameter through the base of the marl into the sandstone. The sinking has reached a depth of about 72 yards, and is intended to be continued to about 100 yards, at which depth the principal feeders were met with in the bore-hole.

Your directors have also to report that during the past year they have purchased Mr. Thomas Wardle's riparian rights in the river Churnet (so far as those are or can be affected by the Tittesworth reservoir) for the sum of £1818 16s. 5d. The service of water to the district has received much attention, and considerable outlay has been involved in re-aranging and improving the distribution.

A vigilant house-to-house inspection is being made, and all service-pipes found wasting water, and too weak to bear the pressure, are being renewed with pipes of proper strength. The result of this careful inspection and prevention of waste has enabled the company to give a longer service of water to a portion of the district, and to dispense with turning off the water on Wednesdays. Your directors hope to still further extend the time of service, and improve the supply, so soon as the consumers fittings can be got into a proper state of repair, and fit to bear the pressure they are required to sustain.

The reservoirs, engines, and other works of the company are in good working order.

A proposal will be submitted to the proprietors at the extraordinary meeting to raise additional capital by the creation of 4200 new shares, as authorized by the "Staffordshire Potteries Water-Works Act, 1868."

The directors, who go out this year by rotation are Joseph Alcock, John Alcock, Charles James Homer, and William Keary, Esqs., but, being eligible for re-election, offer themselves accordingly. Mr. Robert Edwin Narramore, the auditor, who retires by rotation, is eligible for re-election, and the secretary has received notice of his nomination.

The statement of accounts showed a total of receipts under revenue account of £31,049 17s. 1d., which has been disposed of in the shape of £10,794 for dividends, £1857 19s. interest on loans, £2647 19s. 6d. working expenses at pumping-stations, establishment charges—including £2000 for millowner's claims and other heavy items—£8438 3s. 8d., £1000 amount carried to reserve-fund, &c. After all these items have been charged, there remains a balance available for dividend of £6211. The reserve-fund account shows a balance of £3553 4s. 2d.

The CHAIRMAN, in moving the adoption of the report and statement of accounts, said that during the past year they had not had a single complaint as to scarcity of water. He attributed this to the improved mode of distribution which they had adopted, and the stoppage of the waste which had occurred in various parts of the district. With regard to the waste of water, some little dissatisfaction had been expressed, more particularly with reference to the expenses some persons had been put to in renewing their fittings in order to prevent the enormous waste which had been going on for years. He believed there were instances where waste had been going on for months at a considerable flow. Of course, the company did not profess to supply water to have it wasted, and though certain persons might consider it a grievance to be compelled to renew their fittings, it was absolutely necessary that they should do so to prevent waste. The company themselves were about to take up 700 yards of lead piping, in order to substitute iron piping, so that they were not proposing to others what they did not do themselves. It might be asked what they were about to do with the proposed increase of capital. He wished to anticipate questions of that kind. The directors had it in contemplation to make a considerable outlay; in the first place, they proposed to erect a duplicate engine at the Meir, and to renew many of the mains in Longton, several of which were old ones, purchased from the Duke of Sutherland, and wanted renewing. This would involve a considerable outlay. Then there was the reservoir at Birches Head, which leaked considerably. This would have to be put in repair, and possibly covered over.

Rev. W. M. BEEBY seconded the motion.

Mr. S. RHEAD complained that the company had raised the water-rents, based upon the new poor-law valuation for the parish of Stoke, two months before that valuation was put in force by the guardians of the parish.

The CHAIRMAN said the rates levied upon the company's property had been largely increased, and the advanced water-rates would be only about an equivalent.

Mr. BOOTHROYD said the guardians were not bound to act upon the new valuation at once, but the company were bound to adopt the new assessment as soon as it was made.

The motion was then put and carried.

The CHAIRMAN moved that a dividend be declared at the rate of 6 per cent. per annum, for the half year ending March 25, 1877, on £182,000, consolidated stock, clear of income-tax, and that the same be payable by dividend warrants, to be issued to the stockholders on the 25th of June next.

Mr. STEPHEN EDGE seconded the motion, which was carried.

The retiring directors and auditor were severally re-elected.

The CHAIRMAN, in thanking the shareholders for re-electing him, referred to his connexion with the company since the formation, in 1846, and said it was a source of satisfaction to him that they had arrived at such a pitch of prosperity as they had. They had been much abused in the newspapers and by the public about their supply of water, but were now in a position to congratulate themselves upon being able to give satisfaction, not only to the public, but also to the shareholders.

The usual votes of thanks having been passed and acknowledged,

The meeting was made special, for the purpose of creating additional capital.

The CHAIRMAN said it was necessary to keep adding to the capital as their wants increased. They wanted more water to meet the needs of the public, and of course that involved considerable outlay. He therefore moved the following resolution—"That the sum of £21,000, as authorized by the Staffordshire Potteries Water-Works Act, 1868, be raised by the creation of 4200 new shares, or an equivalent amount of stock, of the amount of £5 each, such new shares to be allotted *pro ratâ* amongst the existing stockholders, pursuant to the Companies Clauses Act, 1845."

Mr. NARRAMORE, in seconding the motion, said he felt confident that the money about to be raised would be judicially and properly laid out by the directors.

In answer to questions, Mr. BULL said they were getting more water every day, and the CHAIRMAN said there was a scheme for getting more water elsewhere, but it was not sufficiently mature to talk about.

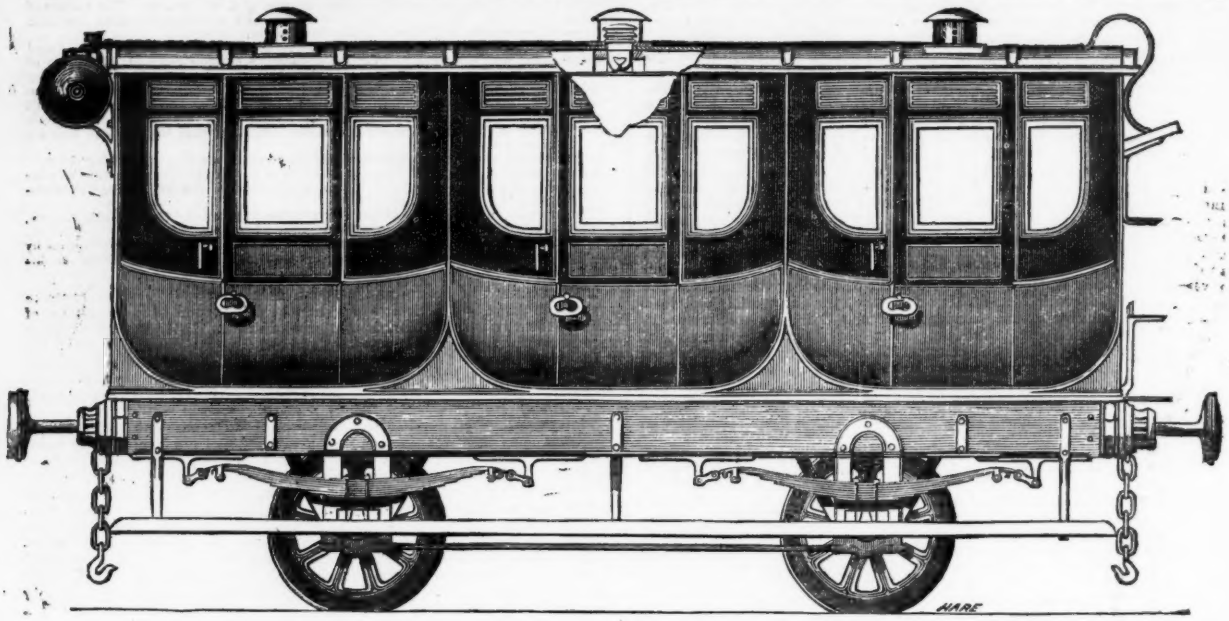
The motion was then carried.

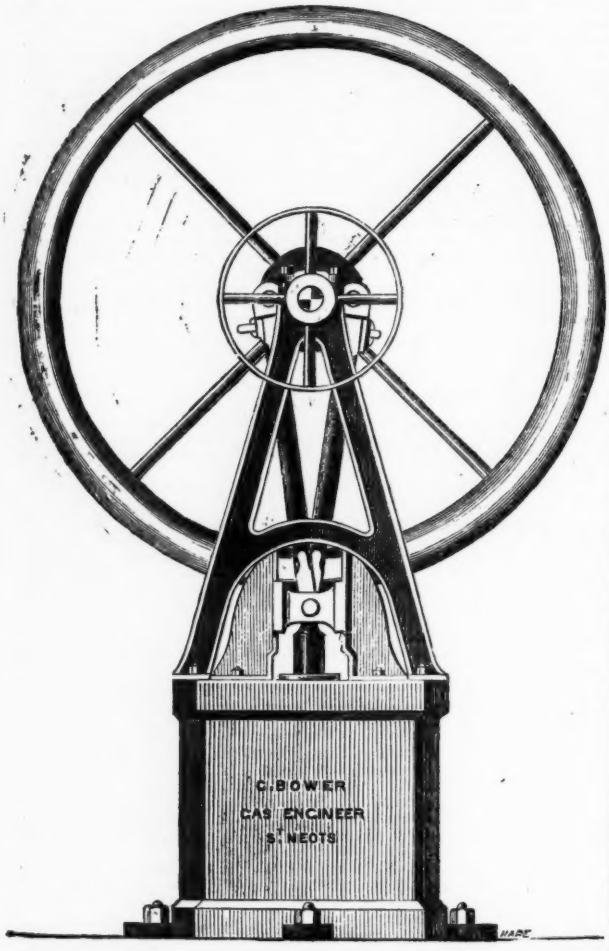
The attention of the shareholders was directed to a museum of effete pipes, by means of which the water of the company had been extensively wasted. It was stated that in the course of examining the pipes in Hanley, one in seven had been found to be defective, the waste of water being enormous.

BOWER'S APPARATUS FOR LIGHTING RAILWAY CARRIAGES WITH GAS, ETC.

Various attempts have been made from time to time to establish a system of lighting railway trains with gas. Some have partially succeeded, but the majority have been failures. Two methods have been usually adopted for this purpose, the arrangements being modified according to the several inventor's peculiar ideas, but substantially the same in principal; the first one consists in using a *dry* or *wet* reciprocating reservoir for the gas, working at the ordinary pressure; the second one is by means of gas at a high pressure, contained in a suitable vessel. In both cases the gas is supplied to the burners by lines of tubing running along the carriages, the connexions between the carriages being made with flexible tubing and union joints.

On the Metropolitan Railway, where the carriages are very long, and where the distance between the termini is very short, the gas is carried





in a box or receptacle on the top of each carriage; but as, in this case, the flexible holders within these boxes can be replenished every few minutes, such a system would not be applicable for trains running long distances. For this purpose, gas at the ordinary pressure would be found too inconvenient and cumbersome; for instance, a train consisting of 12 carriages, running between London and York, say in six hours, each carriage having three lights, and each light consuming 1¼ cubic feet per hour,* would require a storeage capacity for the gas of 350 cubic feet.

Gas supplied from one reservoir also requires joints to connect the carriages, which are difficult to maintain gas-tight, and which are extremely inconvenient when a change of carriages takes place, the disconnexion causing always an inevitable leakage of gas.

What railway companies require, and what it will be necessary for them to have before they can adopt gas illumination for their trains generally, are as follows:—

1. The system must be easy of application.
2. Taking equal amounts of light, and the relative amounts payable for labour, wear and tear, &c., as the bases of comparison, gas must be less costly than oil.
3. Each carriage must carry its own independent supply.

The plan proposed, in order to carry out these conditions, is the following:—At certain stations along the line of railway, where there are pumping engines, and where, of necessity, there must be men to attend to them, let there be gas-works erected for the joint purpose of supplying the stations and the cylinders hereafter named. The gas may be made from Boghead, or other rich cannel, or it may be made from ordinary coal, and afterwards carburetted at the burners; but this would depend upon the locality. If cannel were cheap, the gas should be made from that material; if dear, then from ordinary coal, and enriched by carburation. The retort or retorts should be set by the side of the boiler, if possible, so that the spare heat from the furnace may assist in the generation of steam. At Essendine, on the Great Northern Railway, and other places, where such an arrangement has been adopted, the heat which would otherwise go up the shaft is sufficient to generate the necessary amount of steam, with scarcely any additional fuel, whilst the same man makes the gas and drives the engine and pumps. The gas should be made at such stations in the ordinary way, and condensed into cylinders to a pressure of from 10 to 12 atmospheres or volumes. The cylinders to be placed on brackets at one end of the carriage, and each provided with a valve for regulating the supply to the burners, and also, in the contingency above mentioned, with a carburator.

There should be a supply of cylinders at each station at which the gas was being made for this particular purpose, always ready charged, the pipes and other apparatus attached to the carriage remaining fixtures, whilst the junction between the cylinder and supply-pipe would be made in less time than is now occupied in changing the oil-lamps.

By this plan the tops of the carriages are left free, as at present, for luggage. Each cylinder should be of such a capacity that when filled with gas compressed to a pressure of 10 to 12 atmospheres or volumes, it would be able to supply, say, three lights in each carriage for any given time. For example, supposing the cylinder to be of 14 inches of internal diameter, and 5 feet long, the cubical capacity would be about 5 feet; or when compressed to 10 volumes, capable of containing 50 cubic feet of gas, 45 feet of which would be available for the burners; then if each light consumed 1½ cubic foot, which with rich gas would be about equal to the light of 6 candles (far in excess of what the majority of the lights in railway carriages now give) the supply would last for ten hours. The quantity of gas required for a given length of time can be readily arranged in the first instance, by filling the cylinders to a greater or less pressure. The next thing to be considered is that of cost; and, for this purpose, ordinary gas shall be taken at the rate of 4s. per 1000 cubic feet in the gasholder, including wear and tear, interest on outlay, &c.; carburetting, so as to make it equal to rich cannel gas, say, 3s. 6d. per 1000; extra labour, &c., for pumping into cylinders, 2s. 6d. = 10s. per 1000 cubic feet. The labour, wear and tear, &c., of cylinders and apparatus would not amount to the expense of trimming lamps, lifting them in and out, and of breakages and repairs; but take them as equal, it then becomes a comparison between gas of high illuminating power at 10s. per 1000 cubic feet, and oil at, say, 4s. per gallon; and the result of experiments has proved incontestably that 120 cubic feet of rich cannel or carburetted gas are equal to one gallon of oil.

The capital expended per carriage would be about double that required for ordinary oil-lamps; but the advantage which the railway companies would have in manufacturing their own gas instead of purchasing it at the ordinary rates, would pay good interest on the additional capital invested, besides contributing, in no small degree, to the comfort and convenience of passengers, which, of itself, is of equal importance with any pecuniary saving. The above engraving represents a first-class railway carriage with three compartments; the cylinder containing the gas is shown in position at one end; it is made sufficiently strong to resist a pressure of 30 to 40 atmospheres, and is provided with handles for convenience of moving about, and a strong high-pressure cock and union for attaching to the pump; the outlet is provided with a regulating-valve on an entirely new principle, and which is believed to be a considerable improvement on any others constructed for this purpose; by its means the gas is adjusted to the minimum pressure required, before passing to the burners, no matter what the pressure may be in the cylinders, and a uniform and steady light is constantly maintained. The cylinder is connected to the supply-pipe running along the top of the carriage, by an union joint, so as to be readily attached or disconnected. The covers of the lamps are readily removed for cleaning, &c., the supply-pipe passing through their lower edges into the lamps; if it should be found necessary to take out the lamps, the supply-pipe can also be easily lifted off for that purpose. The second engraving represents the pump required for forcing the gas into the cylinders. It has two barrels and plungers, the barrels being immersed in water for the double purpose of keeping them cool and

* If the gas be made from shale oil or petroleum, three-fourths of a cubic foot per hour would be sufficient.

preventing any escape of gas. It is also provided with a drum or strap-pulley for connecting to the engine. To the outlet from the pumps is attached a gauge, capable of indicating a pressure of from 250 lbs. to 300 lbs. per square inch, so that the attendant will be able, with a little practice, to fill the cylinders to the degree necessary for a journey of any given duration.

INSTITUTION OF CIVIL ENGINEERS.

The concluding Meeting of the Sixtieth Session of this incorporated Society was held on Tuesday, the 29th of May—the PRESIDENT (Mr. George Robert Stephenson), in the chair, as he has been on all occasions when the members have assembled during the past twelve months, emulating in this respect the example of his predecessors, as well as of the members of the council generally, who often, at great personal sacrifices, make it a point of honour and of duty to attend, thus contributing in no small degree to the success of this highly popular and useful body.

At this meeting the monthly ballot took place, and resulted in the election of 45 candidates—viz., 13 members and 32 associates. Amongst the former were Mr. Jonas Proctor, borough engineer of Bolton, and Mr. Thomas William Rumble, chief engineer of the Southwark and Vauxhall Water Company. In the latter were included the names of Messrs. Joseph Dawson, borough surveyor, Stockport; Herbert Oliver Thomas, surveyor to the Woolwich Local Board; George Winn Webb, Gas-Works, Moscow; and George Winstanley, Gas-Works, Coventry.

During the session there have been 23 ordinary meetings, when 12 papers have been read and discussed, with that completeness which always characterizes the proceedings of this society. A brief summary of these communications will show the varied branches of engineering which have occupied attention. In regard to the River Thames, it was demonstrated that the changes in its condition during the last half century, due to the removal of obstructions and other improvements, had added 33 per cent. to the above-bridge tidal volume. The lighthouse system of Japan, the result of treaties between the European Powers and that empire, had led to the establishment of 36 lights, the general form and dimensions of which were described, including the precautions adopted to obviate the effects of earthquake shocks. The repairs and renewals of locomotive engines on some of the leading lines of railway in this country, as well as on the Continent and in the United States, were minutely analyzed, and the causes contributing to the fracture of railway tires were the subject of theoretical investigation. The construction of street tramways, and the use of mechanical motive power on them, was also submitted for consideration. In respect to what might be termed municipal engineering, the supply to be derived from the chalk water system in and around London had been elaborately treated, while the sewage question had been reviewed, and certain conclusions set forth, as to the applicability of various systems and processes under particular circumstances. The history of the modern development of water-pressure machinery was succinctly traced, and the different forms of machines which had come into use were described. The transmission of power by water, steam, compressed air, shafting and ropes, was compared, and in the result it was contended that, where the work to be done was intermittent, the hydraulic system, on the ground of speed, safety, and convenience, was superior to any other. Plans for the combustion of refuse vegetable substances under steam-boilers were discussed, as it was urged that the only method of rendering the use of steam power universal, particularly for agriculture, was to construct the boilers so as to utilize the local supplies of combustible materials of every kind. In a deep boring for coal at Scarle, in Lincolnshire, the carboniferous strata had been reached, and it was deemed desirable that the boring should be continued, as the determination of the eastward extension of the Yorkshire coal-field was important, both economically and from a scientific point of view. The series of papers was terminated by a description of "An Economic Method of Manufacturing Charcoal for Gunpowder." Besides the ordinary meetings, there had been eleven supplemental meetings, exclusively for students, when as many papers were read and discussed. The attendances at all these meetings had far exceeded the average.

The annual publications of the Institution now comprise four volumes of "Minutes of Proceedings," each of nearly 400 pages, and amply illustrated. During the last session there has been an effective increase of two honorary members, 69 members, 94 associates, and 58 students, the numbers of these several classes being now 16, 939, 1691, and 458 respectively; together, 3104, as against 2881 at a similar period last year.

On Thursday evening, May 31, the President of the Institution and Mrs. Stephenson received the members and their friends at the annual *conversazione*, which was held, by permission of the Duke of Richmond, in South Kensington Museum. The throne-room of Akbar Khan, in the Indian Architectural Court, was the first reception-room. It was decorated with azaleas and palms, and all the galleries and halls of the museum were brilliantly lighted up and thrown open to the guests. Several engineering models were exhibited, one of them a tube designed by Mr. Upward for passing food and messages written in phosphorus through a mass of coal to miners entombed in choked borings, with a valve to prevent the rush of compressed air. The music was that of the string band of the Royal Engineers under Herr Sawerthal.

THE TREATMENT OF IRON FOR THE PREVENTION OF CORROSION.

[A paper read at the Society of Arts by Professor BARFF, M.A., Cantab., &c., &c.]

While experimenting two or three years ago with my friend, Mr. Hugh Smith, on different methods for preventing incrustation and corroding of steam-boilers, I was led, through the failure of all the processes employed, to believe that, if it were possible to convert the surfaces of iron plates into the magnetic, or black oxide of iron, in such a manner that the particles of black oxide formed in the position of the original particles of iron could be rendered perfectly adherent to the iron surface, which does not become per-oxidized and perfectly coherent with one another, the object would be effected. I do not intend to enter into the chemistry of the oxidation of iron to its full extent; it would take too much time, and it would rather tend to confuse than to enlighten those who are not well up in their chemistry, and would raise questions which would bring on prematurely a collision with the views of some of my brother chemists, which collision, under suitable circumstances, at some future time not very remote, I look forward to with considerable satisfaction, as it will be the means of solving many phenomena which have never yet been explained. A piece of dry iron, its surface being polished, may be exposed for any length of time to dry air without rusting, but it begins to rust at once as soon as the slightest moisture comes in contact with it. We have to consider only [two oxides of iron—one containing 56 parts by weight of the metal to 16 parts of oxygen, and the other containing twice 56 parts of iron and three times 16 parts by weight of oxygen. We speak of these oxides as the protoxide and sesquioxide, or as ferrous and ferric oxide.

Immediately the protoxide is formed, it being more moist, it unites with oxygen and becomes gradually converted into the ferric oxide. Now, let us suppose a moist iron plate to come into contact with oxygen. It is clear that the protoxide will be first formed, and this rapidly becomes converted into the higher oxide. Now, suppose you take a solution of the salt of the higher oxide and put into it metallic iron, in time, the air being excluded, this higher salt will become converted into a salt of the lower oxide. Let us now see how this bears upon the rapid oxidation of iron in the presence of moisture. We have seen that when oxygen comes in contact with moisture, the first oxide is formed and becomes rapidly oxidized into the higher one. But this higher oxide is in contact with metallic iron, which will reduce it to the lower oxide, thus becoming oxidized by the oxygen which it has taken up from the higher oxide. You will now see clearly how it is that iron rusts throughout its whole substance with such rapidity, for the oxide of iron serves as a carrier for atmospheric oxygen to the iron to almost any depth. There is another oxide of iron, called the black or magnetic oxide, containing three times 56 parts by weight of iron, and four times 16 parts by weight of oxygen. Some chemists consider this oxide to be a sort of mixture of the two others, and they call it ferroso-ferric oxide; whether this be the case or not does not matter to us this evening. But it is a most important point for our consideration that this oxide undergoes no change whatever in the presence of moisture and atmospheric oxygen. Nor does any temperature to which it can be exposed, in any of the ordinary uses to which iron is applied in the presence of moisture, either decompose it or produce its further oxidation. In every school where chemistry is taught, in the most elementary lecture on hydrogen, the pupils are told that if they pass steam over red-hot iron filings contained in an iron tube, they will be able to collect and burn hydrogen gas at the opposite end of the tube to where the steam enters.

For a long time it was thought that the particles of black oxide formed by this decomposition of the steam were pulverulent, and could not be made to cohere into a solid mass. The result of a considerable number of experiments has been to prove that they can be made not only coherent amongst themselves, but adherent to the body, and that both these produce a proper formation of this black oxide on the surface of iron plates; for, as I will show you later on, the oxidized surface of the iron resists for a long time, and more effectually, the rubbing with emery paper, than does the simple metallic iron itself, and that there is a very manifest difference between the ease with which a sharp rasp is able to cut away the surface of the iron, and the difficulty with which this black oxide is removed from the surface by that same instrument.* The method which long experience has taught us is the best for carrying out this process for the protection of iron articles in common use, is to raise the temperature of those articles, in a suitable chamber, say to 500° Fahr., and then pass the steam from a suitable generator into this chamber, keeping these articles for five, six, or seven hours, as the case may be, at that temperature in an atmosphere of superheated steam. I will presently call your attention to the diagram of the furnace and muffle which I have employed in all our later experiments, and in which all the specimens before you, which will be alluded to in this paper, were prepared. Differences of temperature are employed where different objects are to be obtained. If it be wished to act upon surfaces of polished iron or steel, it is desirable to let the temperature remain at 500° Fahr. until the operation is completed. Articles coated in this way will not resist the action of continued moisture such as has prevailed for the last two months, when exposed out of doors; but they will resist the action of any amount of moisture with which they may come in contact in a house or building; and the reason of this will be very obvious, because only a thin film of the iron on its surface is transformed into the black oxide. This I will explain more fully to you when I call your attention to individual specimens. At a temperature of 1200° Fahr., and under an exposure to superheated steam for six or seven hours, the iron surface becomes so changed that it will stand the action of water for any length of time, even if that water be impregnated with the acid fumes of the laboratory.

Before calling your attention to our failures and successes as they lie before you on the table, I will just allude to a few of the uses to which this process may be, as I consider, successfully applied—to water-mains, also to water connecting-pipes, as well as to the water-pipes used inside the house, which, in this case, would supplant their leaden predecessors. In this hall of hygiene, these words will, doubtless, sound as sweet music to the ears of many of those who have honoured me with their attendance this evening. The greatest objection to the use of iron pipes for the supply of water in houses hitherto has been this, that by rusting they caused the first quantities of water drawn off in the morning to be dirty and turbid; now this will be entirely prevented, if the pipes be first exposed to the treatment which I have just explained to you—of course gas-pipes could with advantage be similarly acted upon—and as the surface, when oxidized, is harder than the natural surface of the iron, the friction of large bodies of water through the pipes, and the friction necessarily employed in fixing them in their places, would be much better resisted than by the untreated iron itself.

I cannot over-estimate the advantages which the employment of this process must confer on architects, who will be by it enabled to employ iron, whether wrought or cast, much more largely, not only in the decoration, but in the construction of their buildings. Last summer I was at a very large house in the country, where the entrance portico, some 20 feet high, was being painted and decorated, when one of the large plaster ornaments of the ceiling broke away from its holdings, and would have fallen to the ground, except that it was caught by a workman. This ornament weighed not less than 25lbs., and if it had fallen from this height upon the workmen below, it must have killed them. The ornament had been there many years, and was fixed up in the best method possible, it being supported and secured by iron rods. On examination I found that these rods were rusted through completely to the very centre.

I need not make any comment upon this, since I have been able to introduce you to iron treated in such a way that it will never rust. Of course, if the process will answer for architectural ornaments, it will answer for statues, so that iron may be used instead of bronze, which will materially lessen the cost of casting statues, both in the material and in the expense of making the moulds. You well know that when a tinned saucepan is allowed to get dry on the fire and burns, as the servant calls it, that it is rendered useless until it is tinned again. Now, if such a saucepan be treated by the method I recommend, it may be allowed to get red-hot without suffering injury, for the protection on its surface is produced at a red heat. We have experimented on some screws, hinges, locks, keys, bolts, with complete success. It has been suggested to me that the iron nipples used in gaslights would not corrode, and would, therefore, be more useful, if submitted to this action of superheated steam.

Wherever iron is used, railings, street gas-posts, iron safes for keeping documents fireproof and thief-proof, the framework of filters, tanks, cisterns for domestic and other uses, iron employed in the erection of temporary buildings—which, I flatter myself, if treated by this process, would become permanent buildings—all these and many other applications of iron to the arts would immensely gain by being submitted to this oxidizing action. I think I need hardly take up your time by enumerating other applications for the preservation of iron, for it appears to me that

* Since reading this paper, I have proved that a *flat* rasp does not at all affect the surface of iron coated at 1200° Fahr.

they would be commensurate with most of the uses to which iron is applied, save and except those where friction—such as that to which rails and iron wheels are exposed—would necessarily wear away the coating, as they wear away the material itself.

IRON AND COAL TRADES OF SHEFFIELD, SOUTH YORKSHIRE, AND NORTH DERBYSHIRE.

(FROM OUR OWN CORRESPONDENT.)

The week has again been a quiet one all round, with only a fair amount of business doing in any direction, even at such of the iron and steel works as had attained a slight accumulation of orders during the period of the Whitsuntide holidays.

Pig iron, and all other raw materials, are in moderate request only, so that it is no matter for surprise that prices still hold quiet. All ordinary ores run at 5s. to 8s. per ton, with rather more money for best kinds. West coast hematites rule at 21s. to 23s., in special lots, but the vendors do not give open quotations in a general way. Forge pigs are just now in rather better request, and a few of the most reliable brands of Yorkshire and Derbyshire foundry kinds are in tolerable demand. Agents here for the North Yorkshire smelters quote about the following rates:—No. 1 foundry, 45s. 6d.; No. 2 foundry, 44s.; No. 3 foundry, 42s.; No. 4 foundry, 41s.; No. 4 forge, grey, 40s. 6d.; No. 5 forge, mottled, 40s. 6d.; No. 6 forge, white, 40s.; refined metal 58s. to 59s.; Kentledge, 46s.; and cinder pig, 40s., all net cash. "Airside Leeds," No. 1 is 54s.; No. 2, 52s.; No. 3, 51s.; No. 4, 50s.; forge, 50s.; M., 49s.; and W., 49s. "Acklam Yorkshire," No. 1, 50s. 6d.; No. 2, 49s.; No. 3, 46s. 6d.; No. 4, 46s.; and forge, 45s. "Barbor's Field" (Staffordshire best), No. 1, 105s.; No. 3, 100s.; and No. 4, 100s. North Lincolnshire qualities range from 47s. 6d. to 52s. per ton, according to brand.

There is no particular change in the prices of castings, mains being £5 5s. to £6, smaller pipes £5 10s. to £6 5s., and irregular castings, such as bends, collars, &c., from £6 to £7 10s. per ton.

The coal trade is rather busier, no doubt owing to the strike in Northumberland. At present steam coal is in best request, but should the dispute in the North prove of any duration, all kinds of fuel may become a little stiffer. It would require a long struggle, however, to send up house coals to any appreciable extent, owing to the immense competition in the trade, and the present exceedingly restricted output.

THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

The strike which will inevitably take place this week at the majority of the pits in West Lancashire is causing a rather firmer tone in the market, as consumers have been pushing for extra supplies in order to cover their requirements for a little time forward. It is uncertain how long the struggle may last; the men, who seem determined, have received the support of the Miners' National Union, and there is at present a very unanimous feeling amongst the masters, who declare that under existing circumstances the closing of the pits is almost preferable to going on. So far as stocks are concerned, it is only in one or two exceptional cases that any considerable quantity has been put down on the pit banks, and the large firms in the Manchester district, which will not be affected by the strike, have nothing to spare. Notwithstanding this, however, there is no fear of any actual scarcity, as supplies can readily be drawn from outside districts, and no alteration in list rates has been made this month. In the gas coal trade one or two contracts are reported to have been placed, but in the majority of cases the inquiries in the market do not yet lead to business, and no doubt both buyers and sellers will prefer to wait the result of the strike in the Wigan district. In house-fire classes of coal a tolerably good demand is kept up, and there has been more inquiry for common coal, whilst engine classes of fuel, both burgy and slack, are scarce, and for these rather more is being asked from new customers. The average pit prices remain at 9s. 6d. to 10s. 6d. for good ordinary Arley; 8s. to 9s. for Pemberton four-feet; 6s. 6d. to 7s. 6d. for common coal; 5s. 3d. to 5s. 6d. for burgy; and 4s. to 5s. per ton for slack.

Shipments of the better classes of coal for export have been a little more active, and rather higher prices have been obtainable, but the coasting trade continues dull.

In the iron trade business continues in a very depressed condition, and although nominally, makers quotations are without change, the few sales that have been made during the past week have been mostly small, job lots at about 6d. per ton under the current market prices. In finished iron there is no change, and in all branches makers are complaining of the scarcity of orders and the lowness of prices, even the largest and best known engineering firms in this district being now affected by the prevailing slackness of trade.

THE COAL AND GENERAL TRADE OF THE NORTH.

(FROM OUR OWN CORRESPONDENT.)

The main circumstance which occurred in connexion with the coal trade of the North of England last week was the strike of the Northumberland pitmen. It was rather unexpected, as moderate counsels have prevailed in the union within recent years. But the men took the management of affairs out of the hands of their leaders, and declared war against the masters. The strike is not likely to be a long one, however. In all possibility it will be settled within a fortnight. In the meantime it has occasioned a considerably increased demand for Durham coals of all sorts. Shipping turns, which were three days a fortnight ago in the gas coal trade, are now in many instances three weeks. There is not any appreciable advance in the price of Durham gas coals so far. Steam are higher. The market is stiffer. There has been a great increase of vessels put on to load coals at the Tyne Dock, Sunderland, and Seaham.

A good few shipping orders, which were in the market for steam coals, have been countermanded, and freights fluctuate considerably. The shipments of gas coals are steady, both from the Tyne and the Wear. The coasting trade is quiet. Rates are nominally the same, and a middling business is doing to the Baltic and Mediterranean. There were larger shipments of goods to the Continent last week undoubtedly. They consisted of manufactured iron, chemicals, fire-clay goods, and cement. The chemical trade, however, is unchanged. The demand is limited, and prices are low.

The Miners National Union held their conference in Durham city last week. Various schemes were propounded by delegates to limit the wind of coals, with a view to bring prices up. The subject was remitted to a committee, with a view to a confederation of miners, not only in Great Britain, but throughout Europe, with the object of limiting the production of coal. All the schemes propounded were of a very hazy character, and very little more is likely to be heard of them.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

The annual meeting of the Kettle, Kettlebridge, and Freuchie Gas Company was held a few days ago, when it was resolved to declare a dividend of 5 per cent. It was likewise agreed to extend and improve the present works.

On Friday last, at a meeting of the Dumfries Town Council—Provost Smith presiding—it was resolved to exercise the powers conferred on the council by the Burghs Gas Supply (Scotland) Act, 1876, by giving notice to the Dumfries Gas Company that the council are prepared to treat with them for the purchase of their works and plant, &c., the terms to be mutually agreed upon or fixed by arbitration, in terms of the Act.

It is reported that the estimates of the Perth Gas Commission, for the ensuing year, are to be framed in accordance with a considerable reduction in the price of gas. The present intention is said to be to fix the price of gas for Perth at 4s. 2d., and for Scone at 5s. per 1000 cubic feet.

The annual meeting of the Levin Gaslight Company, Fifeshire, was held on the evening of Monday, the 29th ult.—Mr. R. Aitken, chairman, presiding. A dividend of 10 per cent. was declared, and it was agreed to carry forward the balance to the reserve-fund, the price of gas to remain at 5s. 5d. per 1000 cubic feet, as formerly. Such a satisfactory result of the past year's affairs is regarded as an indication of excellent management.

It would almost seem as if the recent hint about the condition of the gas in the town of Inverness had determined the Gas Commissioners of that town to let the consumers know periodically what kind of gas they are consuming, so far as scientific tests are concerned. One of the local papers gives the following statement in its last issue:—"The quality of the gas supplied to Inverness during the week ending the 26th ult. was as undernoted:—Maximum, 27·96; minimum, 26·83; average illuminating power, 27·38 candles." The record does not state whether the analysis is done by an official examiner, which is a point of some importance when we bear in mind that the weekly reports of the gas examiner and the gas manager at Dumfries show a considerable degree of disparity—rarely less than half a dozen candles.

A special meeting of the Police Commissioners of Inverness was held on Saturday week, for the purpose of examining the law accounts connected with the passing of the Water and Gas Act, 1875, and to make application to the sheriff to appoint an auditor of the accounts of the Gas and Water Commissioners, in terms of the Act. It transpired in the course of the business that the cost of obtaining the Act, exclusive of engineers expenses, was £3165, a large portion of which would not have been incurred had it not been for the opposition of the railway company. In moving that the recommendations of the committee be adopted, the provost remarked that whatever expenses had been incurred had been entered into with the earnest desire to benefit the community, and that in a very short time the full benefit would be enjoyed. They now had a most plentiful supply of pure water, and in the course of a year or two they would have gas at a cheaper rate.

At last the great Forfar "event" has come off. After a trial lasting three days—before Lord Craighill and a jury—the action in the Court of Session, at the instance of Alexander Lowson, coal merchant, Forfar, against William Rutherford, factory manager, was decided last Monday, the jury, by eight to four, returning a verdict in favour of defender. Mr. Lowson claimed £1000 damages, alleged to have been sustained through defender having accused him, as chairman of the Gas Committee of Forfar, of receiving bribes and gratuities from coal masters for procuring the acceptance of their contracts by the corporation. The defender, as well as the pursuer, was a member of the Forfar Gas Commission. Having now got this action decided, it is hoped that the Forfarians will go on with their much-needed water supply as fast as they possibly can.

The other great legal event, the one known as the Dundee Water Action, has been advanced a stage in the Court of Session. Counsel for both sides have been heard by Lord Curriehill, and on Wednesday last that legal dignitary, in the language of the Scotch law courts, "made avizandum with the case." As it seems to have points in law only, I suppose it was not proper that it should go before a jury.

During the past week most of the makers have reduced the prices of their special brands of pig iron, but no great increase of business has followed. Warrants have remained somewhat steady. The closing price on Friday was 54s. cash.

The coal trade is not so busy as it was, and inquiries for shipping orders are fewer.

ROTHERHAM CORPORATION GAS-WORKS.—The Corporation of Rotherham have applied to the Local Government Board for authority to raise £67,000, of which sum £14,000 is required for gas-works extensions. Major Tulloch, one of the Inspectors of the Board, held an inquiry at Rotherham last week, to ascertain and report upon the circumstances of the application.

BECCLES WATER AND GAS COMPANY.—At the annual general meeting of shareholders of the company, on the 28th ult.—Mr. Dashwood in the chair, it was resolved, on the recommendation of the directors, to declare and pay a dividend of five per cent., free of income-tax. The directors reported that the price of gas having been reduced in October last to 5s. 6d. per 1000 feet, the gross income of the company had been diminished by about £123. The directors and auditor whose turn it was to retire remain in office.

NEWARK WATER-WORKS COMPANY.—The annual meeting was held on the 29th ult.—Mr. J. Knight in the chair. The directors presented their report, which was as follows:—The addition to the capital account during the last year amounts to £93 8s. 2d. for additional works. The revenue account for the past year shows the gross revenue of the company during that period to have been £2591 15s. 2d., as against £2477 8s. 11d. in the previous year. The anticipation expressed by the directors in their last annual report, that the outlay made two years ago for new mains, &c., would produce a still larger increase of income, has been fully realized. The balance available for dividend is £1345 4s. 8d., being an increase on last year of £273 12s. The directors recommend the payment of a dividend of £8 per cent., free of income-tax, on the paid-up capital of the company, and that the balance of the revenue account, amounting to £225 4s. 8d., be carried to the reserve-fund. The reserve-fund will then amount to £395 11s. 5d. The works are in a good state of repair, and in satisfactory working order. The report was adopted, the retiring directors re-elected, and an addition of £20 per annum made to the remuneration of the board. A vote of thanks was tendered to the retiring auditor (Mr. A. Taylor), and hearty votes of thanks were also given to the chairman, the directors, and the secretary. The latter, in acknowledging the compliment paid him, said it was now 24 years since the company were established, and they had never been in a more satisfactory or flourishing state.

SALES OF PROVINCIAL GAS SHARES.—On the 23rd ult., at the "Red Lion," Colchester, sixteen old and eleven new £20 fully paid-up shares in the Colchester Gas Company were submitted in eleven lots, and were bought at prices ranging from £37 to £36 10s. per share for the old, and from £26 to £25 10s. for the new, the total amount the shares realized being £869. At the Sheffield Mart, on the 29th ult., ten new £10 shares in the Sheffield Gas Company, £3 paid, were offered for sale by auction, and realized £8 10s. per share premium. At Derby, on the 28th ult., seventy-nine New Ordinary 7 per cent. Shares, of £25 each, of the Derby Gas Company, were offered for sale by auction at the offices of the company, and met with ready purchasers at premiums varying from £17 10s. to £16.

On the same day, at Norwich, thirty £20 shares in the British Gaslight Company, were sold by auction for £1245; also for another proprietor thirty-five shares in the British Gaslight Company, Limited, for £1417. On the 31st, a sale by auction took place at Cambridge, of University and Town Gas Stock and Shares. There were eleven lots of £50 Consolidated Stock, which made an average price each lot of £102 7s. 3d. One lot of £17 stock made £34; eleven lots, each comprising seven £10 shares in the same company, the sum of £7 each only paid up, made an average of £68 7s. 3d.; one lot of £9 reached £82; four lots of £5 each averaged £56 10s. Another lot of £25 10s. Consolidated Stock, and one £10 share, £7 only paid up, made £63. At Elland, on the 1st inst., fifty-two shares, £10 paid, in the Elland-cum-Greetland Gas Company were sold at £21 10s., and £21 14s. per share; twenty-three Preference (£4) shares in the same company sold at £4 12s. each.

CAMBRIDGE UNIVERSITY AND TOWN WATER-WORKS.—The foundation stone of a new engine-house, at the works, Cherryhinton Road, was laid on Tuesday, the 29th ult., by the Rev. Dr. Okes. The foundation stone bore the following inscription:—"The Cambridge University and Town Water-Works were opened by the late Rev. W. Whewell, D.D., Master of Trinity College, and Chairman of the Company, on the 23rd of October, 1855; and this foundation stone of a new engine-house, in connexion with an increased power of supply, was set on the 29th of May, 1877, by the Rev. Richd. Okes, D.D., Provost of King's College, Chairman of the Company." The building, the foundation stone of which was thus laid, is connected with one portion of very important additions to the company's works, which have been rendered necessary in order to provide a supply of water for the increasing wants of the University and Town of Cambridge and contiguous places. At the pumping-station further steam and engine power is being provided, which will be capable of raising an additional quantity of water at the rate of 720,000 gallons in 24 hours. In order to ensure a regular supply, and at the same time to increase the effective pressure, a duplicate main has been laid down between Hyde Park Corner and the railway bridge, on the Hills Road, and this will before long be continued to Cherryhinton. Besides this, numerous but important additions have been made to the distributing apparatus within the district of supply, which will effect great improvements in certain parts. New mains have been laid down where required, and the size of many sub-districts has been reduced, thereby adding to the convenience of the consumers of water from the company's works. The whole of the new works have been designed by, and are being executed under the superintendence of the company's engineer, Mr. Henry Tomlison, A.I.C.E.

Register of New Patents.

APPLICATIONS FOR LETTERS PATENT.

2038.—SONNENTHAL, R., Aldermanbury, London, "Improvements in glass water-gauges." A communication. May 25, 1877.

2055.—GORDON, J., Glasgow, "Improvements in valves and apparatus for controlling and regulating the supply of water and preventing waste." May 26, 1877.

2056.—SHANKS, J., Renfrew, N.B., "Improvements in and connected with lavatories, baths, cisterns, water-closets, and other apparatus for the use of water." May 26, 1877.

2069.—BRETT, R. W., Hertford, "Improvements in lanterns for public or private lighting, and in the mode of supporting the same." May 28, 1877.

2085.—BUDENBERG, A., Manchester, and HURTER, F., Widnes, Lancs, "Improvements in pressure, vacuum, and speed gauges and recorders." Partly a communication. May 29, 1877.

2094.—CLARK, A. M., Chancery Lane, London, "Improvements in electric light apparatus." A communication. May 29, 1877.

2095.—CLARK, A. M., Chancery Lane, London, "Improvements in valve apparatus for lavatory and water-closet basins, baths, and other similar uses." A communication. May 29, 1877.

2105.—REDWOOD, T., Lower Clapton, and REDWOOD, T. B., North Finchley, "Improvements in the manufacture of gas for burning." May 30, 1877.

2116.—BRADSHAW, A., Accrington, Lancs, "Improvements in the construction of pressure-gauges." May 31, 1877.

2125.—SMEATON, W. M., Strand, London, "Improved mechanical arrangements for preventing waste and regulating the flow of water, specially useful for water-closets." May 31, 1877.

PATENTS WHICH HAVE PASSED THE GREAT SEAL.

4668.—THORPE, C., and PRINCE, H., Manchester, "Improvements in the construction of direct-acting steam-pumps." Dec. 2, 1876.

4675.—HOWARD, E., Walthamstow, Essex, "Improvements in apparatus for preventing waste of water in water supply to closets, drinking fountains, wash-hand basins, and other water-supply appliances." Dec. 2, 1876.

4784.—CAMERON, J., Salford, Lancs, "Improvements in the construction of steam-pumps." Dec. 11, 1876.

4807.—RITCHIE, C., Brixton, London, "Improvements in or applicable to apparatus for utilizing heat for lighting, heating, and ventilating." Dec. 13, 1876.

4824.—FOULIS, W., Glasgow, "Improvements in drawing retorts, and in the machinery or apparatus employed therefor." Dec. 13, 1876.

952.—HALLSWORTH, S., and BAILES, R., Leeds, "Improvements in the means or method of treating and clarifying sewage or other impure waters." March 9, 1877.

PATENTS WHICH HAVE BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £50 BEFORE THE EXPIRATION OF THE THIRD YEAR.

1550.—KNOWLES, Sir F. C., "Improved manufacture of gas for heating purposes." May 2, 1874.

1567.—LOWNE, R. M., "Improvements in anemometers and other fluid meters." May 4, 1874.

1589.—LENOIR, F., "Improved apparatus for carburetting gas." May 5, 1874.

1709.—BUDENBERG, A., "Improvements in meters for measuring the flow of liquids." May 14, 1874.

1733.—PONTIFEX, E. A., "Improvements in apparatus to be used in drawing off water and other liquors, and in measuring the quantities drawn off." May 15, 1874.

1799.—ALEXANDER, E. P., "Improvements in liquid-meters, applicable also as a motive-power engine." May 21, 1874.

1820.—WHITEHOUSE, E. O. W., "Improvements in producing electric light." May 22, 1874.

PATENT WHICH HAS BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £100 BEFORE THE EXPIRATION OF THE SEVENTH YEAR.

1311.—WEARE, R., "Improvements in apparatus for receiving and treating sewage and other noxious matters." May 7, 1870.

1472.—LLOYD, T. H., "Improvements in the construction and arrangement of valves for regulating the supply or discharge of steam, water, and other fluids." May 21, 1870.

1486.—LONG, A., "Improvements in means for regulating the flow or controlling the supply of water or other fluids." May 23, 1870.

Share List of Metropolitan Gas and Water Companies.

(Corrected by Mr. F. N. GOLDING, Sun Court, Cornhill, from the latest Stock Exchange Quotations.)

Number of Shares issued.	Amount per Share.	NAME.	Amount paid up per Share.	Last Divd. p.Cent. p. Ann.	Latest Quotations.
	£	GAS COMPANIES.	£ s. d	£ s. d	£
10000	20	Anglo-Romano . .	20 0 0	9 0 0	20—22
5000	20	Bahia (Limited). .	20 0 0	2 0 0	14—16
1000	20	Do., do., redeem.	20 0 0	2 0 0	25—27
1500	20	Do., 2nd pref. . .	20 0 0	7 10 0	21—22
40000	5	Bombay (Limited).	5 0 0	7 10 0	6¾—7¼
10000	5	Do., fourth issue.	4 0 0	7 0 0	5—5½
10000	20	British (Limited) .	20 0 0	10 0 0	41—43
7500	20	Cagliari (Limited).	20 0 0	5 0 0	118—119
550000*l.*	Sk.	*Commercial* . . .	100 0 0	10 0 0	206—211
70000	100	Do., 7 per cent. .	..	..	145—150
20000	20	Continental Union.	20 0 0	6 0 0	20—22
10000	20	Do., new	12 10 0	6 0 0	par—1
10000	20	Do., preference .	20 0 0	7 0 0	25—27
75000	Sk.	*Crystal Palace District*	100 0 0	10 0 0	210—215
125000	Sk.	Do., 7 per cent. .	100 0 0	7 0 0	150—155
50000	Sk.	Do., preference .	100 0 0	6 0 0	135—140
23406	10	European (Limited)	10 0 0	10 0 0	17½—18½
12000	10	Do., new shares.	7 10 0	10 0 0	5—7 pm.
35406	10	Do., new shares .	5 0 0	10 0 0	4¾—5¼pm
37977704	Sk.	*Gaslight & Coke* A.	100 0 0	10 0 0	205—208
100000*l.*	Sk.	Do. B.	100 0 0	4 0 0	85—90
30000	10	Do. 5 per ct. pref. conv., 3rd issue.	all	5 0 0	20½—21
50000	10	Do. do., 4th do. .	6 0 0	5 0 0	7¼—8¼pm
50000	10	Do. do., 5th do. .	2 0 0	5 0 0	7—8 pm.
200000*l.*	Sk.	Do. C 10 p.c. pref.	100 0 0	10 0 0	225—235
300000*l.*	,,	Do. D do. do. .	100 0 0	10 0 0	225—235
165000*l.*	,,	Do. E do. do. .	100 0 0	10 0 0	225—235
30000*l.*	,,	Do. F 5 do. do. .	100 0 0	5 0 0	114—116
60000*l.*	,,	Do. G 7½ do. do. .	100 0 0	7 10 0	158—162
13000000	,,	Do. H	100 0 0	7 0 0	147—150
6200	5	Georgetown, Guiana	5 0 0	5 0 0	..
5800	10	Hong Kong (Lim.)	10 0 0	10 0 0	18—19
56000	50	*Imprl. Continental*	43 15 0	9 10 0	91—93
2500000*l.*	Sk.	*London*	100 0 0	10 0 0	208—213
100000*l.*	Sk.	Do., 1st pref. . .	100 0 0	6 0 0	138—143
14450	Sk.	Do., 2nd pref. . .	100 0 0	6 0 0	115—120
4350	Sk.	Do., 3rd pref. . .	100 0 0	6 0 0	115—120
7622	25	Do., A shares . .	12 10 0	6 0 0	34—36
268054	All	Do., Debent. stk.	100 0 0	*M.& G.*	..
15000	5	Malta and Mediterranean (Limited).	5 0 0	2 0 0	2—3
6000	5	Do., preference .	5 0 0	7 10 0	5—5½
22000	5	Mauritius (Limited)	2 0 0	..	¼—1
25000	20	Monte Video (Lim.)	20 0 0	8 0 0	18¼—19½
8000	10	Nictheroy, Brazil (Limited)	10 0 0	3 0 0	..
30000	5	Oriental (Calcutta).	5 0 0	9 10 0	7⅞—8¼
30000	5	Do., new shares .	3 0 0	9 10 0	1½—2 pm
10000	5	Ottoman (Limited).	5 0 0	3 0 0	2—3
17500	10	Pará (Limited) . .	10 0 0	7 0 0	5—6
27000	20	*Phœniz*	20 0 0	10 0 0	41—43
3600004	100	Do., new	60 0 0	7 10 0	104—109
144000*l.*	Sk.	Do., capitalized .	100 0 0	5 0 0	106—112
		Do., new, 1876. .	..	..	17–18pm
36000	20	Rio de Janeiro (L.)	20 0 0	10 0 0	31—33
7359	5	Singapore (Limited)	5 0 0	7 10 0	5¼—5⅞
2000	5	Do., preference .	5 0 0	7 10 0	5⅞—6¼
1500	32½	Shanghai	32 10 0	12 0 0	30—32
4000	50	*South Metropolitan*	50 0 0	10 0 0	106—109
4000	12½	Do.	12 10 0	10 0 0	26—28
20000	12½	Do., new shares .	10 10 0	10 0 0	12½—13½ pm.
15000	10	*Surrey Consumers.*	10 0 0	10 0 0	20—22
10000	10	Do., new	8 0 0	10 0 0	8½—9½
9000	4	United General . .	4 0 0	2 10 0	3—3¼
1500	10	*Wandsw. & Putney*	10 0 0	10 0 0	19—20
1500	10	Do.	10 0 0	7 10 0	11—12
2957	10	Do.	10 0 0	7 0 0	..
993	10	Do.	3 0 0	7 0 0	..
23000	5	*West Ham*	5 0 0	10 0 0	8—8½
		WATER COMPANIES.			
12000	100	Chelsea	100 0 0	6 0 0	144—147
1800000	100	East London . . .	100 0 0	6 0 0	154—157
8000	50	Grand Junction . .	50 0 0	5 0 0	73—76
5840	25	Do., ¼ shares . .	25 0 0	5 0 0	36¼—37½
2160	25	Do., new ditto; max. div., 7½ p.c.	25 0 0	5 0 0	31—33
547960	100	Kent	100 0 0	8 0 0	194—198
970	100	Lambeth	100 0 0	6 5 0	143—150
1161	100	Do., max., 7½ p.c.	100 0 0	6 5 0	143—147
442	100	New River	100 0 0	7 0 0	320—330
4475	100	Do.	70 0 0	7 0 0	270—300
400000	100	Do., deb. sk., 4 p.c.	100 0 0	4 0 0	103—105
3036	100	Southwrk. & Vauxh.	100 0 0	4 0 0	109—112
1296	100	Do., pref. stock .	100 0 0	5 0 0	113—116
..	100	Do., D shares . .	100 0 0	4 0 0	106—110
..	..	Do., 4½ prcference	100 0 0	4 10 0	106—108
..	100	Do., new ordinary	..	4 10 0	..
1600	100	Do., new ord. No. 1	40 0 0	4 10 0	106—108
12172	61	West Middlesex . .	61 0 0	6*l.*p.sh.	134—136

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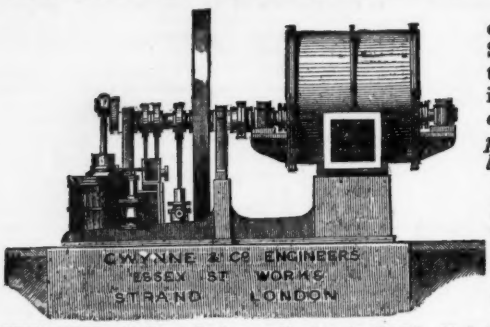

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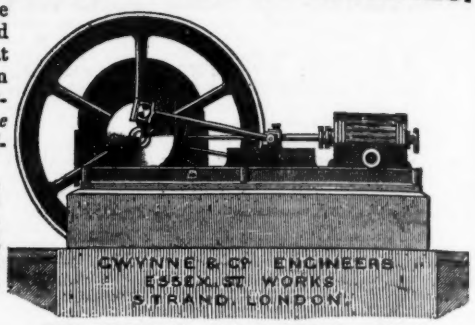
The Judges report on the combined Exhauster and Steam-Engine exhibited at the Philadelphia Exhibition is—"*Reliable compact Machine, well adapted for the purpose intended, of excellent workmanship.*"

GWYNNE & CO. have made the largest and most perfect Gas-Exhausting Machinery in the world, and have completed Exhausters to the extent of 7,000,000 cubic feet passed per hour, of all sizes from 2000 to 210,000 cubic feet per hour.



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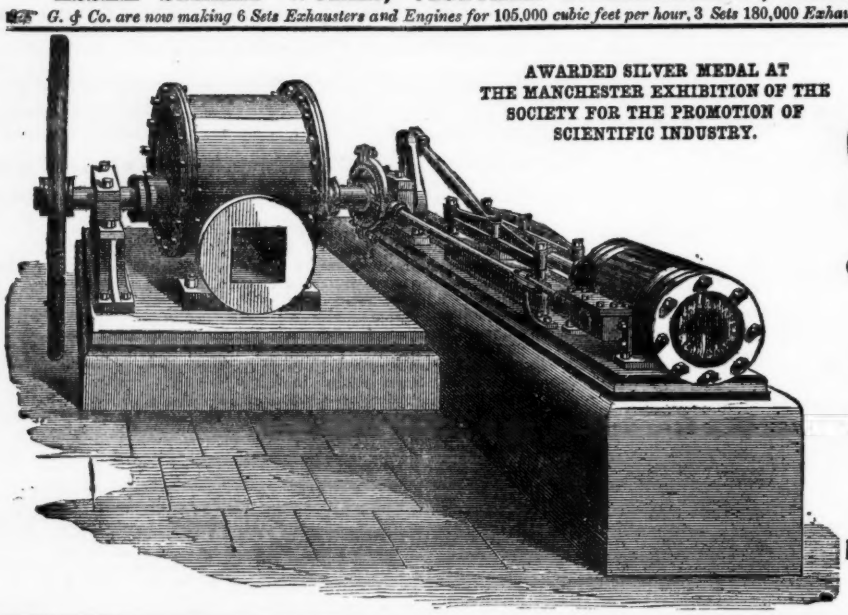

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BRITISH

ASSOCIATION OF GAS MANAGERS.

ANNUAL MEETING OF MEMBERS.

PROGRAMME OF ARRANGEMENTS.

THE

FOURTEENTH ANNUAL GENERAL MEETING

OF THE MEMBERS OF THIS ASSOCIATION WILL BE HELD ON

TUESDAY, WEDNESDAY, & THURSDAY, the 12th, 13th, & 14th of June, 1877,

AT THE

LECTURE THEATRE OF THE BRISTOL MUSEUM,

QUEEN'S ROAD, BRISTOL.

ROBERT P. SPICE, ESQ., MEMB. INST. C.E., PRESIDENT,

Will occupy the Chair.

ORDER OF PROCEEDINGS.

TUESDAY, JUNE 12, 1877.—Morning Meeting.

The Chair to be taken at Ten o'clock.

Inaugural Address by the President. | Admission of New Members.
Reading of Papers and Communications.

Evening Meeting.

A Lecture will be delivered by THOMAS CARGILL, C.E., B.A., T.C.D., President of the Society of Engineers (Author of "The Strains upon Bridge Girders and Roof Trusses"), on "The Strains upon Girders, Trusses, and Braced Structures, and the Mode of Ascertaining and Calculating them."

WEDNESDAY, JUNE 13, 1877.

The Chair to be taken at Ten o'clock.

Reading of Papers and Communications, and the Transaction of other Business, Election of Officers for the ensuing Year, &c.

At Six p.m. the Members and Friends will dine together at the Grand Hotel, Broad Street, Bristol.

Tickets for the Dinner, 6s. 6d. each, may be had from the Secretary, if taken on or before the 12th of June. After that date 10s. will be charged.

THURSDAY, JUNE 14, 1877.

An Excursion by Rail to New Passage, across the Severn by Steamboat to Portskewet, thence by Rail to Chepstow, where the Castle may be inspected. Luncheon will take place in the town, and carriages will be provided for conveying the party through the beautiful scenery of the Wyndcliffe to the magnificent ruins of Tintern Abbey.

Tickets for the Excursion and Luncheon, 7s. 6d. each.

LIST OF PAPERS AND COMMUNICATIONS

TO BE SUBMITTED TO THE MEETING.

SUBJECT FOR DISCUSSION:

"THE CONSTITUTION AND RULES OF THE BENEVOLENT-FUND."

The Order in which the Papers are to be Read will be determined by the Committee prior to the Meeting, so as to suit the general convenience.

1. "Experience of Körting-Cleland's Steam-Jet Gas-Exhauster, with Notes on its Adaptability and Economy." By R. O. PATERSON, of Cheltenham.
2. "Some Experiments upon the Power and Fuel expended in Exhausting Gas." By C. WOODALL, of London.
3. "Periodical District Pressure-Taking." By W. J. WARNER, of South Shields.
4. "The Supply of Gas to Public Lamps." By R. W. BRETT, of Hertford.
5. "Evidences of Economy in Carbonization by the Use of West's System." By J. ELDRIDGE, of Richmond.
6. "Lighting and Extinguishing Automatically." By A. F. WILSON, of London.
7. "Railway Carriage Lighting." By W. SUGG, of London.
8. "Is the Adoption of the Form of Accounts as Scheduled in the Gas-Works Clauses Act, 1871, by all Gas Companies or Corporations desirable." By ALFRED LASS, of London.
9. "Scrubbing and its Results." By S. R. OGDEN, of Blackburn.
10. "Means of Extending the Use of Gas and Coke, and How their Consumption may be Increased." By W. H. BENNETT, of London.

May 28, 1877. WILLIAM H. BENNETT, *Secretary.*

MAIN and Service Layer wanted. Address, stating age, wages, and present employment, No. 368, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

THE Advertiser is desirous of meeting with an Appointment as Gas-Works Manager. He has been employed by his present employers eight years, four of which he has had sole charge of the Works, where the annual make is over 80 million cubic feet. Advertiser understands the manufacture and distribution of gas in all its branches, and is willing to be paid either by results or salary. Good references and testimonials can be given.

Address, JOHN HENRY LYON, Gas Engineer, MACCLESFIELD.

AYLSHAM, NORFOLK.

AYLSHAM GAS COMPANY, LIMITED.

WANTED, by the Directors of this Company, a MANAGER for their small works, to make and distribute Gas. The salary is £1 per week, with house, garden, coals, and gas, and to enter on duties at the end of August next.

Applications, with testimonials as to character and fitness for the office, to be sent to me on or before the 21st of June next.

Candidates will be informed if their presence is required on the day of election.

W. HENRY SCOTT, Secretary to the Company.

Aylsham, May 30, 1877.

TO GAS COMPANIES.

WE beg to call attention to our special STEATITE BURNERS for Street Lamps. Sample gross 8s. Quotations for quantities.

Messrs. TINDALL AND TELLING, Gas Apparatus Works, 74, Wynford Road, Penton Street, LONDON, N.

FOR SALE, CHEAP, owing to exten sions, Three PURIFIERS, with valves and connexions, in good order.

Apply to the Gas Company, NORTHALLERTON.

FOR SALE, CHEAP, 400 4-inch Cast- Iron SOCKET-PIPES, coated.

Apply by letter to J. MYERS, 5, Fortess Terrace West, JUNCTION ROAD, N.W.

CHELTENHAM GAS-WORKS.

FOR SALE, Two Hydraulic Centre- VALVES and 12-inch connexions, suitable for sets of Four and Two purifiers. All in good order.

READING GAS COMPANY.

FOR SALE, as they now stand, and at any reasonable price, as the ground upon which they stand is wanted, four 12-ft. square Cast-Iron PURIFIERS, with centre-valve and connexions, grids, tee bars, &c., complete.

Apply to Mr. E. BAKER, Engineer, Gas-Works, READING.

GASHOLDER FOR SALE.

TO BE SOLD CHEAP, in consequence of the tank being wanted for another purpose, a GAS-HOLDER about 33 ft. in diameter and 10 ft. deep. To be sold, as it now stands, at any reasonable price. Is in good condition.

Apply to Mr. W. T. HEWS, Gas-Works, HENLEY-ON-THAMES.

TO TAR DISTILLERS AND OTHERS.

TO BE LET ON LEASE, or the Interest SOLD, a very handy TAR-WORKS in London. In good order, and capable of working nearly a million gallons per year. Water frontage.

Address No. 362, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

MIDDLESEX LUNATIC ASYLUM, COLNEY HATCH, N.

GAS TAR FOR SALE.—About 5000 gallons of GAS TAR now for Sale at the Gas-Works of this Asylum; to be removed immediately.

Tenders are invited, naming price per gallon and time within which the whole would be removed, to be sent, addressed to me at the Asylum, by Saturday, the 9th of June. Payment to be made on delivery.

J. S. SKAIFE, Clerk.

GASHOLDER FOR SALE.

ONE Telescopic Gasholder, 70 feet by 20 feet, complete, with cast-iron tank, columns, girders, and inlet and outlet pipes, valves, &c., of modern construction. In first-class condition, and made by Messrs. Piggott and Co., of Birmingham.

To be seen at work at the Gas-Works, Birkenhead.

Cause of removal to make room for extensions.

To be sold a bargain, taken down, and re-erected ready for work.

For particulars, apply to Messrs. ASHMORE AND WHILE, STOCKTON-ON-TEES, or to view to Mr. CALLOW, Gas Engineer, BIRKENHEAD.

THE Newport (Mon.) Gas Company have FOR SALE the following PLANT at their Works, Newport, Mon.:—

Two Cylindrical Boilers, 13 ft. by 4 ft., with fittings complete, and steam-pipes to engines.

Two Horizontal Engines, each cylinder 9½ in. diameter, and stroke of each 1 ft. 6 in.

Two Beale's Exhausters, made to pass 20,000 cubic feet per hour each, with regulators and bye-pass.

The above are in good order, have been working during the past winter, and are now offered for sale because larger ones have been fixed.

Particulars and prices given for the whole or a portion of the Plant on application to the undersigned.

They can be seen at the Works, Mill Street, Newport, Mon.

THOMAS CANNING, Engineer.

May 18, 1877.

PATRONIZED BY THE ROYAL ARSENAL, WOOLWICH.

FERGUSON, Builder and Contractor. Kite method of Repairing Church Spires and High Chimneys. Chimneys straightened, pointed, and hooped. Old Chimneys pulled down by a process requiring no scaffolding or stoppage of work, by competent workmen, under personal supervision. For Lightning Conductors—cheapness and method of fixing—apply to C. R. FERGUSON, 12, Canal Road, MILE END.

IMPERIAL CONTINENTAL GAS ASSOCIATION.

(Incorporated by Act of Parliament.)

The HALF-YEARLY ORDINARY MEETING of the Imperial Continental Gas Association was held at the City Terminus Hotel, Cannon Street, London, on TUESDAY, the 29th inst.,

JULIAN GOLDSMID, Esq., M.P., the Chairman,

when the following resolutions were passed:—Resolved unanimously—"That the Report upont he affairs of the Association now read be received, adopted, and entered on the minutes." Resolved unanimously—"That a dividend of £2 per share, and a bonus of 15s. per share, be declared upon the 56,000 shares of the Association for the half year ended the 31st of December last, and that the said dividend and bonus be payable free of income-tax, on and after the 15th of June next."

Resolved unanimously—

"That Julian Goldsmid, Esq., M.P., be re-elected a Director of the Association."

"That Nathaniel Montefiore, Esq., be re-elected a Director of the Association."

"That Francis Bassett, Esq., be re-elected a Director of the Association."

"That Joseph Sebag, Esq., be re-elected an Auditor of the Association."

"That the cordial thanks of the Meeting be given to the President and Directors for their able management of the affairs of the Association, and to the Chairman for his conduct in the chair this day."

Upon the motion of the Chairman, Mr. Julian Goldsmid, M.P., a vote of thanks was also given to Mr. G. W. Drory, the General Superintendent of the affairs of the Association on the Continent, and to the Agents, Engineers, and other Officers of the Association.

Albert F. Jackson, Secretary.

By order of the Board.

No. 30, Clement's Lane, Lombard Street, London, May 30, 1877.

CARDIFF GASLIGHT AND COKE COMPANY.

AMMONIACAL LIQUOR.

THE Directors of this Company are prepared to receive TENDERS for the AMMONIACAL LIQUOR produced at their Works in Cardiff, for One, Two, or Three years, from June 30, 1877.

Sealed tenders, endorsed "Tender for Ammoniacal Liquor," to be forwarded to the undersigned, on or before the 6th day of June next.

Any further particulars may be obtained upon application at the Company's Offices.

Henry Bowen, Engineer.

Gas Offices, Cardiff, May 12, 1877.

TO CONTRACTORS, GASHOLDER-TANK BUILDERS, AND OTHERS.

THE Directors of the Sherborne Gas and Coke Company are prepared to receive TENDERS for the construction of a GASHOLDER-TANK in Brick at their Works.

Drawings and specification may be seen, and full particulars obtained, on application to Mr. T. W. R. White, the Engineer.

Tenders are to be sent in on or before Monday, the 11th of June next, endorsed "Tender for Gasholder-Tank," and addressed to the Secretary.

The Directors do not bind themselves to accept the lowest or any tender.

By order,
T. W. R. White, Secretary.

May 30, 1877.

TO TAR DISTILLERS, MANUFACTURING CHEMISTS, AND OTHERS.

THE Directors of the Rochester, Chatham, and Strood Gaslight Company are prepared to receive TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR produced at their Works at Rochester and at Gillingham for the term of One year, commencing the 1st of July next.

Particulars on application at the Office of the Company at Rochester.

Tenders may be for Tar or Liquor, separately or together, and are to be delivered at the Office, marked "Tender for Tar or Liquor," not later than Noon of Thursday, the 14th of June.

The Directors do not bind themselves to accept the highest or any tender, and security for due fulfilment of the Contract may be required.

By order,
William Syms, Secretary.

May 28, 1877.

IMPORTANT SALE OF SHARES

In the Woolwich Equitable Gas Company, the Woolwich Consumers Gas Company, and the Clacton-on-Sea Gas and Water Company, Limited, by direction of the Executors of the late Mr. John Webber.

MR. H. H. CHURCH is instructed to SELL by PUBLIC AUCTION, at the Masonic Hall, William Street, Woolwich, on Thursday, June 28, 1877, at Four for Five o'clock in the Afternoon, Seventy-six £10 ORIGINAL SHARES, fully paid up, in the Woolwich Equitable Gas Company, and paying an annual dividend of £10 per cent. Thirty-eight £10 ADDITIONAL SHARES in the same Company, whereon £2 per share have been paid, paying an annual dividend of £7½ per cent. Thirty £5 SHARES, third issue, fully paid up, in the Woolwich Consumers Gas Company, paying an annual dividend of £7½ per cent. Five £5 NEW SHARES in the same Company, fully paid up, and paying a dividend of £7½ per cent. per annum; also Twenty £5 B SHARES, all paid up, in the Clacton-on-Sea Gas and Water Company, Limited.

Particulars and Conditions of Sale may be had of Messrs. Farnfield and Sampson, Solicitors, 19 and 21, Queen Victoria Street, London, and Parson's Hill, Woolwich, and of the Auctioneer, William Street, Woolwich.

PAMPHLET ON GAS.

COOKING AND HEATING.

HINTS ON GAS-BURNERS, &c.

For GAS COMPANIES to distribute to their Gas Consumers.

Specimen Copy by post Threepence, from the Author,
MAGNUS OHREN, Gas-Works, Sydenham, S.E.

Just Published, Price 2s. 6d.,

COMMON SENSE FOR GAS USERS,

Being a Catechism of Gas Lighting for Householders, Gas-Fitters, Architects, Engineers, Millowners, &c.

By ROBERT WILSON, C.E.

CROSBY, LOCKWOOD, & CO., 7, STATIONERS HALL COURT, E.C.

BRAZILIAN IRON-WORKS, MALTON, YORKSHIRE.

THOMAS READ & CO.,

General Ironfounders and Manufacturers

OF

GAS AND WATER SOCKET-PIPES,

2-inch to 8-inch, can supply from Stock.

London Agent:

J. MYERS, 5, FORTESS TERRACE WEST, JUNCTION ROAD, N.W.

J. EDMUNDSON & CO.,

19, GREAT GEORGE STREET, WESTMINSTER, LONDON, S.W.,

MANUFACTURERS OF EVERY DESCRIPTION OF

GAS APPARATUS.

CONTRACTORS FOR THE

ERECTION OF GAS-WORKS, GAS-FITTINGS, &c.,

FOR TOWNS, COUNTRY MANSIONS, &c.

Estimates given free of Charge.

J. & J. BRADDOCK,

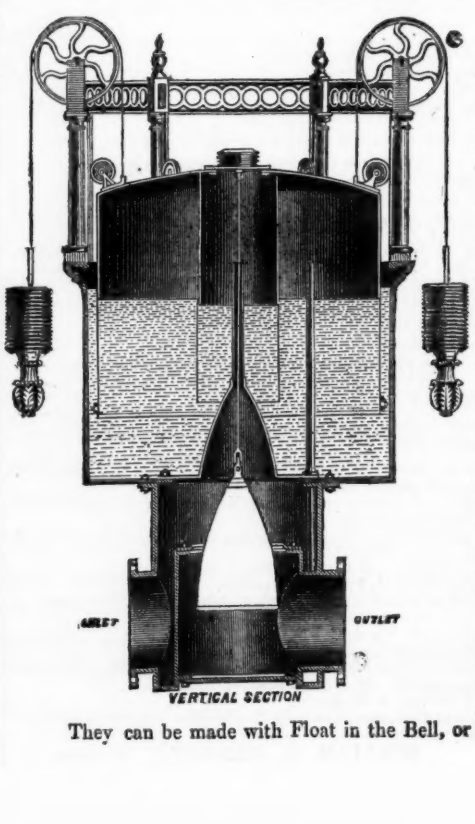
GLOBE METER-WORKS,

OLDHAM,

Beg to submit to Gas Engineers their

PATENT COMPENSATING GAS GOVERNOR,

Which is designed to give an uniform pressure at the Outlet to the Main at all draughts up to the full quantities which the Governors are made to control, such outlet pressure being less than the initial pressure.



VERTICAL SECTION

The uniformity of pressure is obtained by introducing a compensating chamber into the Bell or Holder of the Governor, which compensator is of the same area as the valve, both of which are operated on by the initial pressure, thereby placing the valve in equilibrium, no matter what the initial pressure may be. The action on the Bell is by the Gas passing along a pipe from the outlet, and the pressure is regulated by weights in connexion with the Bell as required.

From the sectional elevation attached hereto, it will be seen that only the Gas required to operate the Bell comes in contact with the water of the tank, which water will remain comparatively sweet and free from odour. That in case of accident to the Bell, no more Gas can escape than would pass up the pipe covering the valve-rod and Bell supply-pipe.

These Governors have been made and sent out of various sizes for from 2 to 24-inch Mains, and give most satisfactory results.

They can be made with Float in the Bell, or counterpoise as per section.

JOHN HALL AND CO., STOURBRIDGE,

Manufacturers of FIRE-BRICKS, LUMPS, TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

N.B.—A Stock of 15 and 16 in. CIRCULAR RETORTS always on hand. Other kinds made to order on short Notice.

GAS PURIFICATION.

BAILES & HALLSWORTH,

CONTRACTORS FOR THE

PURIFICATION OF COAL GAS,

BY THEIR

PATENT OXIDE OF IRON COMPOUND.

The material is in use at most of the principal Gas-Works in Yorkshire and elsewhere. It contains considerably less moisture than natural Oxide of Iron. It is much cheaper and more efficient as a purifying agent.

B. & H. are purchasers of Spent Oxide, or will take Spent in exchange for New Material.

FOR SAMPLES AND TERMS, ADDRESS—

BAILES & HALLSWORTH, COPPERAS WORKS, ARMLEY, LEEDS.

GEORGE ANDERSON,

GAS AND CONSULTING ENGINEER,

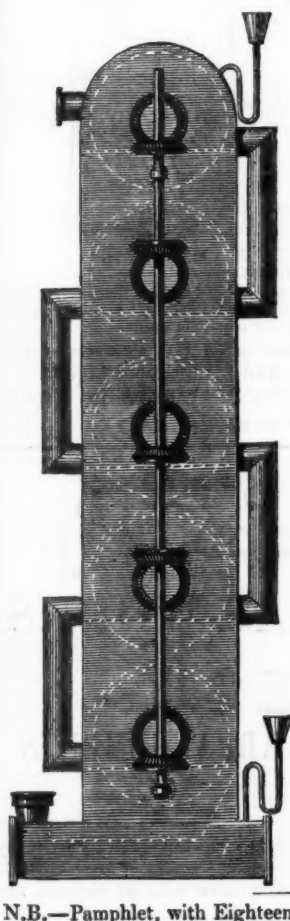
35A, GREAT GEORGE STREET,

WESTMINSTER, S.W.

ANDERSON'S

PATENT

COMBINED WASHER AND SCRUBBER.



TESTIMONY OF ITS ACTION.

The Gas-Works, St. Albans,
April 27, 1877.

DEAR SIR,

Your Brush Scrubber has been in action here for four months.

It removes the whole of the ammonia from the gas, so that it will not discolour moistened turmeric paper.

The brushes cause no appreciable increase of pressure, and there is no repumping of liquor. Clear water run in at top, issues from the bottom fit to proceed to the sulphate-house.

It performs its work more efficiently than the tower scrubber I have, while only about half the height, and not one-fourth its weight or capacity.

My purifiers also last much longer before they are foul than they did previously.

I am, yours truly,

A. F. PHILLIPS.

G. Anderson, Esq.,
35a, Great George Street, S.W.

PATENTEE and MANUFACTURER of the following Inventions:—

RETORT SETTINGS—giving great Economy of Fuel.

STEAM-ENGINES and EXHAUSTERS, FOUR-WAY VALVES.

FUEL-MACHINE, for Compressing Breeze and Tar.

N.B.—Pamphlet, with Eighteen Illustrations and Letterpress on the Construction of Gas-Works, post free, 2s. 6d.

PRICES AND ALL PARTICULARS TO BE HAD OF THE PATENTEE,

35a, GREAT GEORGE STREET, WESTMINSTER, S.W.

TO TAR DISTILLERS, DYE MANUFACTURERS, AND OTHERS.

THE Directors of the Swansea Gaslight Company are prepared to receive TENDERS for the purchase of the TAR produced at the Gas-Works, Swansea.

Tenders to be sent in on or before Thursday, June 14.

For information as to terms and conditions, apply to the undersigned,

THORNTON ANDREWS, Secretary and Manager.

Swansea, April 24, 1877.

TO INVENTORS AND PATENTEES.

MR. W. H. BENNETT, having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to say that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their invention may be secured for Six Months; or LETTERS PATENT, which are granted for Fourteen Years.

Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.

Patents procured for Foreign Countries.

Information as to cost, &c., supplied gratuitously upon application to the Advertiser, 12, Great George Street, WESTMINSTER.

T. NEWBIGGING,

CONSULTING GAS ENGINEER,

5, NORFOLK STREET, MANCHESTER.

HENRY LYON,

ENGINEER,

AND

CONSULTING GAS ENGINEER,

BARTON HOUSE, opposite BARTON ARCADE,

DEANSGATE, MANCHESTER.

ALFRED LASS,

SPECIAL ACCOUNTANT FOR GAS COMPANIES,

30, GRACECHURCH STREET, LONDON.

Accounts analyzed and Statistics Prepared for Parliamentary Proceedings, Arbitrations, &c.

The Forms of Account, which have been specially designed by A. L. to meet the requirements of the Gas-Works Clauses Amendment Act, 1871, are now in use by many Gas Companies, and have been universally approved.

The above forms are registered.

Water Companies Accounts also prepared and adjusted.

CONSULTATIONS.

ADDISON POTTER,

WILLINGTON QUAY,

NEAR NEWCASTLE-UPON-TYNE,

Manufacturer of

CLAY RETORTS, FIRE-BRICKS, AND EVERY DESCRIPTION OF FIRE-CLAY GOODS

BOUCK & CO., LIMITED,

TAR DISTILLERS & MANUFACTURING CHEMISTS,

MILES PLATTING, MANCHESTER.

BUYERS OF COAL TAR,

And Crude Products therefrom,

AMMONIACAL LIQUOR, &c.

W. HAILES,

FURNACE BUILDER AND RETORT-SETTER,

Contracts for the

BUILDING AND SETTING OF RETORT BENCHES,

In large or small works, at home or abroad;

Also to supply all kinds of

FIRE GOODS AND IRONWORK

Necessary for the Erection of Retort-Beds.

The greatest amount of heat by the smallest possible amount of fuel is the principle of the settings.

ADDRESS:

No. 3, High Street, Brentford, MIDDLESEX.

YEO'S PATENT ENGINE PACKING AND IMPROVED YARN FOR GAS AND WATER PIPE JOINTS.

EPHRAIM YEO, Inventor, Patentee, and Sole Manufacturer of the Patent Excelsior Self-Lubricating Rope Engine Packing, price 1s. 8d. per lb., any size. Carriage paid on ¼ cwt. and upwards to any Railway Station in the Kingdom. Best Tarred Spun-Yarn for Gas-Pipe Joints, 28s. per cwt. Best White Ditto, any size, 36s. per cwt. Best Ditto, boiled in Oil and Tallow, 36s. per cwt. Coke Sacks, any length or width, Tarred or Untarred. Carriage paid to any Railway Station in the Kingdom. Address—

E. YEO, NEWTON ABBOT, DEVONSHIRE.

HEBBURN MAIN GAS COALS.

T. Stone, Esq., of Weymouth, writes on Nov. 17, 1876: "I have used about 12,000 tons of this Coal, with, I think, the best possible results, although not always under the most favourable circumstances. My Coal account made up to Midsummer last showed a makeage of 10,524 cubic feet per ton of 14¼-candle gas, and not a hundredweight of Cannel used. This statement would, I know, be incredible to many men, and may provoke the remark, 'How much of it is paid for?' For the gratification of such, I have to say that, of the above quantity, 9866 cubic feet per ton of Coal carbonized were brought to charge and duly paid for, with the exception of about 6s. per cent. for bad debts. The coke is of excellent quality. The above facts I hold to be a greater recommendation to your Coal than any words of mine could be."

THE TYNE COAL COMPANY, LIMITED, OWNERS.

W. RICHARDSON, Fitter,

29, QUAYSIDE, NEWCASTLE-ON-TYNE.

WILSON'S
PATENT SAFETY PRESSURELESS
AUTOMATIC DIP-PIPES,
Fixed or moveable, adapted to works of any size, without other alteration than removal of existing Dips.

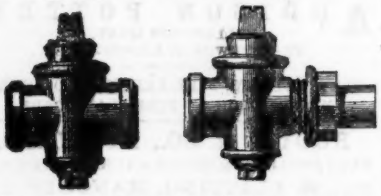
W. P. WILSON, 98, ASYLUM ROAD, S.E.

HOPKINS, GILKES, & CO.,
LIMITED,
MIDDLESBOROUGH,
SUPPLY GAS & WATER PIPES of EVERY SIZE.
Plain, Turned and Bored, and Coated.
CAST-IRON RETORTS.
Castings for Gas-Works of every description.
EXHAUSTERS.
LONDON OFFICE: 25, LAURENCE POUNTNEY LANE.

GAS COMPANIES
AND
LOCAL BOARDS
Requiring New Street-Lamps are recommended
KEEN'S PATENT
DOUBLE-CLIP
STREET-LAMP.
A great improvement on the old-fashioned 14-in. Lamps.
They have been sold to various Gas-Works throughout the country and abroad, and the highest satisfactory testimonials are given as to their superiority.
For particulars of price, &c., apply to
WILLIAM KEEN, Sole Proprietor and Manufacturer, Robertson Street, HASTINGS.

LAMBERT'S
CAST-IRON GAS-MAIN COCKS,
WITH PATENT WHITE METAL PLUGS.
TRADE (L) MARK.

No. 758. No. 759.



The bodies of these Taps are made of iron, black or galvanized, and the plugs of patent metal. They are warranted not to set fast or corrode, as do Iron or Brass Cocks; will always work easily; are strong, well made, durable; of little or no intrinsic value, and therefore not likely to be stolen; and the prices as stated below are (especially upon the larger sizes) fully 50 per cent. less than Brass Cocks.

	½	¾	1	1¼	1½	2-inch.
No. 758, with inside screws for iron pipe, black	2/0	3/0	4/4	6/6	7/6	12/0 each.
No. 759, with union on one end screwed inside for iron pipe, black	2/9	3/10	5/4	8/0	9/0	15/6 each.
Nos. 758 and 759, galvanized	0/3	0/4	0/6	0/8	0/10	1/4 extra.

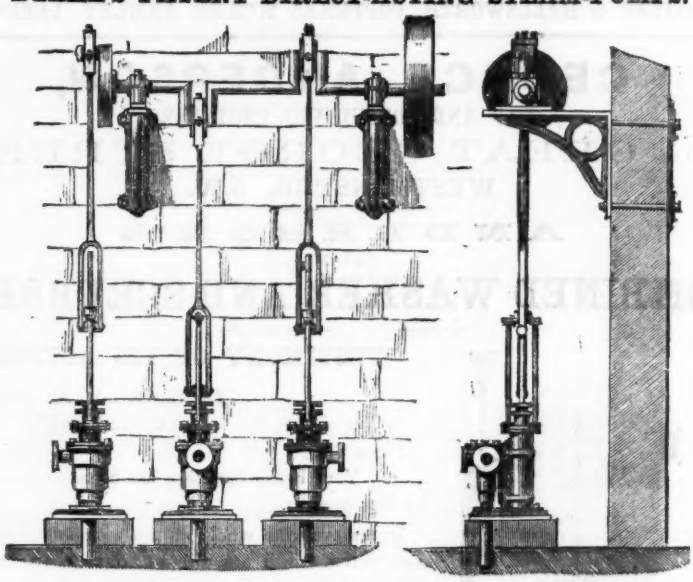
MANUFACTORY:
SHORT STREET, LAMBETH, LONDON.

CATHELS'S
IMPROVED RETORT-SETTINGS.
GUARANTEED TO HEAT AND WEAR WELL, WITH GREAT ECONOMY OF FUEL.

Coloured lithograph copies of WORKING DRAWINGS of Beds of One to Seven Retorts (so clearly arranged and fully shown as to be easily understood by any retort setter or bricklayer) having been made of these valuable settings, they can now be supplied with detailed SPECIFICATION immediately on receipt of orders.

APPLY TO
MR. THOS. NEWBIGGING,
CONSULTING GAS ENGINEER,
5, NORFOLK STREET, MANCHESTER.

S. OWENS & CO.,
WHITEFRIARS STREET, FLEET STREET, LONDON, E.C.,
Hydraulic Engineers,
AND MANUFACTURERS OF
PUMPING MACHINERY of every Description.
SOLE LICENSEES AND MANUFACTURERS FOR GREAT BRITAIN OF
BLAKE'S PATENT DIRECT-ACTING STEAM-PUMPS.



IMPROVED DOUBLE-ACTION PUMPS.
For Water. For Tar. For Ammoniacal Liquor.

This illustration shows an arrangement of three (No. 179) Improved Double-Action Pumps driven from the same crank-shaft, as frequently supplied for use in Gas and Chemical Works. The suction and discharge pipes can be arranged for drawing from and delivering in any required direction.
These Pumps have been supplied to nearly all the large Gas Companies and Chemical Works, both for Pumping Water, Tar, and Ammoniacal Liquor.
GAS SYPHON PUMPS, IN COPPER OR SHEET IRON, ALWAYS IN STOCK.
Illustrated Catalogues sent post free on application.

EDWARD COCKEY & SONS,
GAS ENGINEERS, FROME SELWOOD,
MANUFACTURERS OF ALL DESCRIPTIONS OF
APPARATUS CONNECTED WITH GAS-WORKS.
THE ORIGINAL PATENTEES AND MANUFACTURERS OF THE
DRY-FACED VALVES
FOR PURIFIERS, GASHOLDERS, BYE-PASS, AND OTHER ARRANGEMENTS REQUIRING VALVES IN GAS-WORKS.

The Faced Valves, as made by the Patentees, continue to give great satisfaction, and they are being used extensively by many of the best gas engineers of the day.
They are more easily repaired than any other kind of Valve in use, and can be re-ground in a few hours without removal, and made perfectly gas-tight.
References can be given to many Engineers of high standing, who will testify as to the favour in which they are held.

MANUFACTURERS ALSO OF SUPERIOR WOOD GRIDS FOR PURIFIERS, SCRUBBERS, &c.

J. T. B. PORTER & CO.,

GAS ENGINEERS & MANUFACTURERS,

IRONFOUNDERS AND CONTRACTORS,

GOWTS BRIDGE WORKS,

LINCOLN.

LONDON OFFICES: 1, WESTMINSTER CHAMBERS, S.W.

ESTIMATES FOR GAS-WORKS OF ANY SIZE.

REFERENCES TO 500 WORKS ALREADY ERECTED.

N.B.—All Communications to be addressed to the FIRM ONLY.

THOMAS CARR & SON,

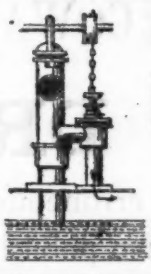
MANUFACTURERS OF

FIRE-BRICKS, LUMPS, TILES, RETORTS, &c., &c.,

SCOTSWOOD FIRE-BRICK WORKS,

SCOTSWOOD-ON-TYNE.

COPP'S PATENT ANTI-DIP GAS APPARATUS.



Produces from 10 to 20 per cent. more gas of higher illuminating power.
Prevents the deposit of carbon.
Retorts last much longer.
Charges work off quicker.
This simple invention has been in use in many works for the last six months, with the above results.

PRICE 2 GUINEAS EACH.

Testimonials and particulars on application.

Address WALTER L. COPP, WATCHET, SOMERSET.

HENRY GREENE & SON,

GAS AND HOT WATER ENGINEERS,

155, CANNON STREET, E.C.

Manufactory: 19 & 20, NICHOLAS LANE, E.C.

SUN-BURNERS,

With Regulating Valves to obviate down draught.

MEDIÆVAL & OTHER GAS-FITTINGS

For Churches and Domestic Use.

ARCHITECTS' OWN DESIGNS WORKED OUT.

ESTIMATES FREE OF CHARGE.

THE TRADE SUPPLIED.

SOLE CONSIGNEES FOR BRÖNNER'S IMPROVEMENTS IN GAS LIGHTING.

IN THE MATTER OF

BRÖNNER'S GAS-BURNERS.

HENRY GREENE AND SON, 155, Cannon Street, London, Sole Agents for Great Britain, Ireland, and Colonies, of Brönner's Improvements in Gas Lighting, beg to inform the public that on the 13th of January, 1876, Julius Brönner obtained an injunction in the Court of Session, Scotland, against Donald M'Vean, Gas-Fitter, 14, Newton Street, Glasgow, prohibiting him from in any way advertising or offering for sale as Brönner's Burners, any Burner not manufactured by Julius Brönner, or from in any way inducing the public to believe that the said Donald M'Vean sells or keeps for sale Brönner's Burners, manufactured by Julius Brönner, while such is not the case.

Also that on the 9th of November, 1875, he obtained injunction in the same Court, and in the same terms, against R. M. Brechin and Co., 46, North Hanover Street, Edinburgh.

Also that on the 20th of April, 1875, in a suit in Chancery, before Vice-Chancellor Malins, number 1874, B 365, he obtained injunction against another defendant, in the same terms and on similar grounds.

MESSRS. NEWTON, CHAMBERS, & CO.,

THORNCLIFFE IRON-WORKS, NEAR SHEFFIELD,

MANUFACTURERS OF

IMPROVED CENTRE-VALVES,

PURIFIERS, CONDENSERS, SCRUBBERS, GASHOLDERS, ROOFS,

And every description of Gas Machinery.

TENDERS GIVEN FOR WORK FIXED COMPLETE IN ANY PART OF THE KINGDOM.

WEST'S GAS IMPROVEMENT COMPANY,

LIMITED,

ARE NOW PREPARED TO SUPPLY AND ERECT THEIR PATENTED MACHINERY FOR

CHARGING AND DRAWING GAS-RETORTS,

And to enter into arrangements with GAS COMPANIES for its use upon moderate terms of Royalty.

The Patented Machinery has secured the approbation of all Engineers who have visited the MAIDSTONE GAS-WORKS, *where it is in full operation, and may be inspected at any time on application to the Manager.*

The advantages attending its use are—

INCREASED VOLUME OF GAS PER TON.—INCREASED YIELD PER RETORT.—INCREASED BULK OF COKE FOR SALE.—REDUCTION IN LABOUR AND LESS DEPENDENCE ON SKILLED STOKERS.

A Pamphlet containing a description of the Machinery, and Copies of Reports on the working of the same, &c., will be forwarded on application to the MANAGING DIRECTOR, Maidstone. Communications may also be addressed to the Consulting Engineer, R. P. SPICE, Esq., M. Inst. C.E., 21, Parliament Street, London, S.W., or to the Engineer and Analyst, F. W. HARTLEY, Esq., A. Inst. C.E., 55, Millbank Street, London, S.W.

W. & B. COWAN,

ORIGINAL LICENSEES AND MANUFACTURERS OF

WARNER & COWAN'S SELF-REGULATING GAS-METER.

DRY METERS.

It has been erroneously stated by some, and inferred by a few others, that the views we have published on Dry Meters arise from hostility or indifference to the Dry Meter trade; and it has also been stated that we now regret having given expression to those views — a statement equally without foundation; and although our position as one of the largest DRY METER MAKERS might be supposed to free us from such imputations — and does so with our own customers—we, nevertheless, think it right to call general attention to the fact, that our opinions as to the impossibility of making the Dry Meter as reliable as the Wet, have never for a moment caused a relaxation of our efforts to make it as perfect as its principle admits.

The fact of its being a "Dry" Meter, cannot, of course, be got rid of, nor the consequences flowing therefrom; but (as our Dry Meters prove), it can be made to give general satisfaction, and very little trouble in use.

To remedy the defects and improve the character of Meters generally, has always been our aim, and the Dry, no less than the Wet, has received our earnest attention; and although, in pointing out the paramount merits of the WARNER & COWAN METER, we have found it necessary to compare unfavourably with it all Dry Meters, as we have had to do all Wet Meters, it must not be inferred that our Dry Meter trade is now securing less of that attention which has placed us in the position of one of the largest manufacturers of Dry Meters.

Meter-making not being one of the "giant industries," a statement of the number of persons we employ might lead to a false estimate of the extent of our business by those not acquainted with the trade; but to those who are, the fact that (after all the labour-saving machinery and arrangements we have introduced) we still employ upwards of 300 persons, will sufficiently show our position relatively to that of others engaged in the same business.

W. & B. COWAN,

WET & DRY GAS-METER MANUFACTURERS,

(ESTABLISHED 1827,)

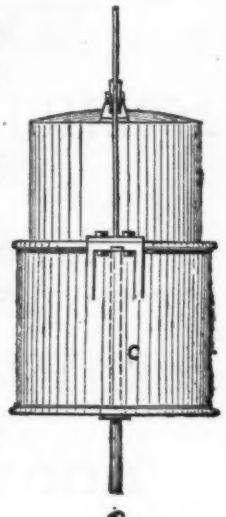
CHURCH STREET, MILLBANK STREET, **LONDON, S.W.** | **FENNEL STREET, MANCHESTER.** | BUCCLEUCH ST. WORKS, **EDINBURGH.**

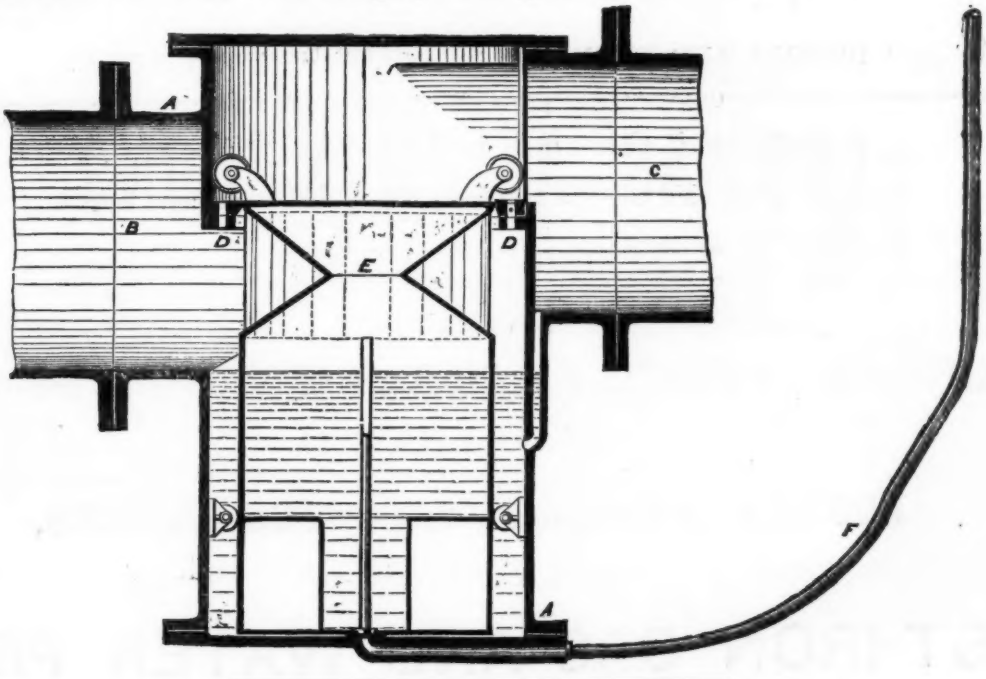
FOULIS'S
PATENT STATION & DISTRICT GAS-GOVERNOR.

For Description, see "Journal of Gas Lighting," May 1, 1877.

These Governors possess the following Advantages:—

1. They are much smaller than any other, being no larger than an ordinary water-trap for the same size of main.
2. The moving parts are few and light, thus ensuring great sensitiveness in action.
3. They may be placed anywhere underground in the line of pipe, and regulated from any distance, or for district purposes they may be made self-acting.
4. No house or covering is required.
5. The prices are considerably less than those constructed on the ordinary principle.





For Prices and Particulars, apply to
W. & B. COWAN,
WET & DRY GAS-METER MANUFACTURERS,

(ESTABLISHED 1827,)

CHURCH STREET, MILLBANK STREET, LONDON, S.W.

FENNEL STREET, MANCHESTER.

BUCCLEUCH ST. WORKS, EDINBURGH.

JOHN ABBOT AND CO.,

LIMITED,

IRON AND BRASS FOUNDERS,

PARK WORKS, GATESHEAD-ON-TYNE.

London Office: 2, SUFFOLK LANE, CANNON STREET.

Glasgow Office: 54, ST. ENOCH'S SQUARE.

MANUFACTURERS OF ALL DESCRIPTIONS OF

HYDRAULIC MACHINERY,

INCLUDING

ACCUMULATORS, FORCE-PUMPS, CRANES, & LIFTS,

FOR

GAS-WORKS, WAREHOUSES, &c.

IMPROVED HYDRAULIC MACHINERY,

Specially Arranged for Lifting and Lowering Purifier-Covers, &c.

MAKERS OF

PURIFIERS, CONDENSERS, SCRUBBERS, RETORTS;

PIPES FOR GAS AND WATER WORKS;

ROOFS, COLUMNS, AND GIRDERS.

DESIGNS AND ESTIMATES SUPPLIED ON APPLICATION.

THOMAS ALLAN & SONS,

IRONFOUNDERS,

WORKS:

SPRINGBANK FOUNDRY & NORTH WOODSIDE FOUNDRY,

GLASGOW;

BONLEA FOUNDRY, STOCKTON-ON-TEES,

Manufacturers of

CAST-IRON GAS AND WATER PIPES.

SIZES: ¾ to 12 inches at GLASGOW.

„ 1½ to 7 „ STOCKTON.

A LARGE STOCK KEPT, AND PRICES MODERATE.

Freight to London, in the Stream, 10s. per ton from Stockton; 12s. 6d. from Glasgow.

London Agent: Mr. A. C. FRASER, ST. STEPHEN'S CHAMBERS, TELEGRAPH STREET.

THE WIGAN COAL & IRON COMPANY,
LIMITED.

DISTRICT OFFICE: 97, NEW STREET, BIRMINGHAM; AGENT: W. M'GOWAN;

Supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, &c.

N.B.—The Wigan Coal and Iron Company, Limited, are exclusive owners of the well-known HAIGH HALL AND KIRKLESS HALL GAS COAL COLLIERIES.

GAS PURIFICATION & CHEMICAL Co., LIMITED,
(Successors to JOHN WILLIAM O'NEILL & CO.,)

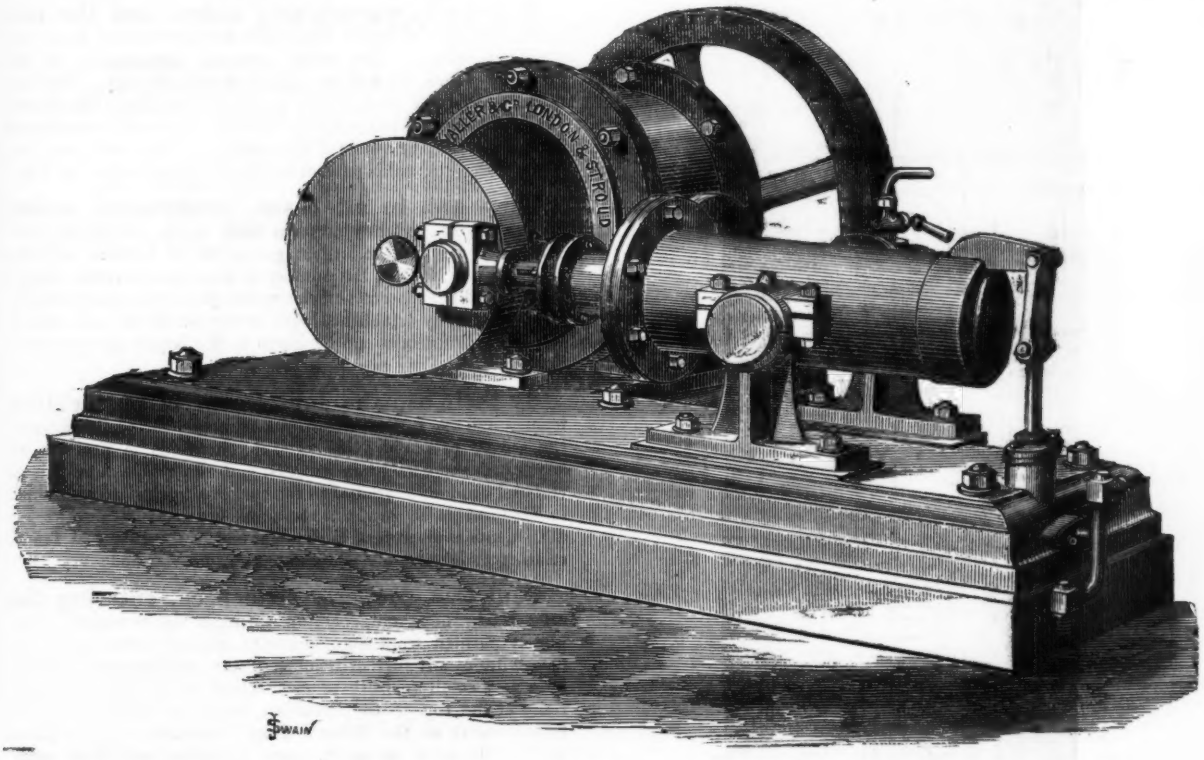
Offices—PALMERSTON BUILDINGS, OLD BROAD STREET, LONDON, E.C.,

CONTRACTORS FOR GAS PURIFICATION BY OXIDE OF IRON.

The superiority of the material supplied by this Company is generally recognized, and it is now in use in nearly all the London and most of the large Provincial Gas-Works.

JOHN WILLIAM O'NEILL, SAMUEL H. JOHNSON, } Joint Managing Directors.

GEORGE WALLER & CO.,
GAS ENGINEERS AND CONTRACTORS.



THIS

COMBINED ENGINE AND EXHAUSTER

Has been specially designed by G. W. & Co. for small works, making from 300 to 1000 cubic feet per hour; they occupy very small space, and being complete on one base-plate, are easily fixed.

The Exhausters are of large capacity for driving at moderate speed, and the whole apparatus simple in construction and of best workmanship.

NOTE.—They are always kept in Stock, with Valves, Governors, Pumps, and other Apparatus required in Gas-Works.

Phœnix Engineering Works, Holland Street, Southwark, S.E.

C. & W. WALKER,
8, FINSBURY CIRCUS,
LONDON, E.C.

MANN & WALKERS' PATENT SCRUBBER.

By Letters Patent in Great Britain, Europe, and the United States of America.

By some important improvements recently patented, the purifying power of these Scrubbers has been much increased, and a stronger ammoniacal solution obtained, which is found to absorb a large portion of the carbonic acid contained in gas, effecting an important saving in money and labour in the lime purifiers, and where oxide only is used, the increase in the illuminating power of the gas obtained by these Scrubbers is shown in a remarkable degree, in consequence of the large quantity of carbonic acid removed from the gas.

It is to be particularly noted that the important results of these Scrubbers do not depend upon the machinery alone. The entire internal construction of the Scrubber bears an almost equally important part. For this reason, where it is desirable to convert existing Scrubbers, whose dimensions happen to be suitable, the work commences by ripping out the whole of the interior of the shell, and beginning the internal construction *de novo* from bottom to top.

They are, in all cases, constructed under guarantees to perfectly perform their work. They are now extensively used in the largest gas-works of London and the chief cities of Europe, the number in use exceeds **one hundred,** and their perfect efficiency and profit to a gas company have been fully established with every variety of coal used in Europe. References can be given to the largest gas-works in Europe.

By their use the department of purification from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals, generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

They contain their own engine power, requiring only a small inappreciable quantity of steam from the gas-works boiler, and are then complete in themselves, ready for service.

Applications relating to dimensions and prices should be addressed to us, C. AND W. WALKER, 8, FINSBURY CIRCUS, LONDON, E.C., or to Mr. WILLIAM MANN, late Superintendent of the Chartered Gas-Works, BLACKFRIARS, LONDON; they should state approximately the largest make of gas in 24 hours on a winter's day, and the smallest make on a summer's day, to be purified.

F. & C. OSLER,

45, OXFORD STREET, LONDON, W.

MANUFACTORY AND SHOW-ROOMS:

BROAD STREET, BIRMINGHAM.

ESTABLISHED 1807.

MANUFACTURERS OF CRYSTAL GLASS CHANDELIERS

WALL LIGHTS, AND LUSTRES FOR GAS AND CANDLES.

TABLE GLASS OF ALL KINDS.

CHANDELIERS IN BRONZE AND ORMOLU. MODERATOR LAMPS.

TO GAS COMPANIES AND THE TRADE.

J. DEFRIES & SONS,

MANUFACTURERS OF

CRYSTAL, BRONZED, & ORMOLU CHANDELIERS, IMPROVED CRYSTAL STAR & SUN LIGHTS, VESTIBULE LAMPS, AND THE PATENT CRYSTAL ILLUMINATION.

A LARGE STOCK ALWAYS IN HAND OF

IRON, BRASS, COMPOSITE, AND LEAD TUBES, FOR GAS AND WATER,

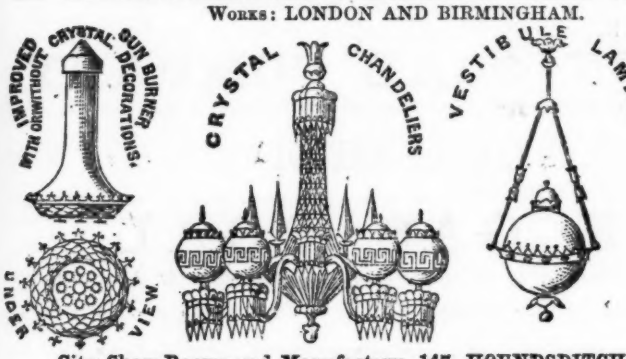
AND EVERY DESCRIPTION OF

GAS AND WATER FITTINGS.

THE PATENT DRY AND WET METER, WITH THE LATEST IMPROVEMENTS.

STREET LAMPS AND COLUMNS IN GREAT VARIETY.

WORKS: LONDON AND BIRMINGHAM.



GAS MOONS,
Cut and Engraved, of the newest designs

GAS REFLECTORS
In Silver and Glass

GAS NIBS AND BURNERS
Of every description.

Pattern-Books of Gas-Fittings, Crystal and Ormolu Chandeliers for 1876, are now complete.

City Show-Rooms and Manufactory, 147, HOUNDSDITCH, LONDON.

ESTABLISHED 1830.

LESMAHAGOW CANNEL COAL.

FERRAND DAVIES,

148, GRESHAM HOUSE, OLD BROAD STREET, LONDON, E.C.,

SOLE AGENT FOR

THOMAS BARR'S LESMAHAGOW MAIN CANNEL.

Quotation and Analysis forwarded on application.

G. J. EVESON,

GAS COAL AND CANNEL FACTOR,

Has on offer, in quantities to suit purchasers, Best Wigan Arley Mine, Orrell Screened and Unscreened Gas Coal and Nuts; Best Yorkshire, Real Old Silkstone, Derbyshire, and North Staffordshire Screened and Unscreened Gas Coal and Nuts; also Best Lancashire, Yorkshire, Derbyshire, and other Cannel, as supplied to some of the principal Gas Companies in England, to whom references are permitted.

Analysis and Prices forwarded on application to

HEAD OFFICES, STOURBRIDGE.

N.B.—Gas Managers will oblige by advising when they will be prepared to receive Tenders.

STOURBRIDGE FIRE-BRICKS, RETORTS, CLAY, &c.

ROBERT MARSHALL,

CANNEL COAL MERCHANT,

173, ST. VINCENT STREET, GLASGOW.

SHOTT'S BOGHEAD.

LOTHIAN'S CANNEL

Yields 12,500 cubic feet of 34-candle gas per ton, and 9 cwts. of excellent coke, containing only 4 per cent. of ash.

MUIRKIRK, No. 1, CANNEL

Yields 12,160 cubic feet of 32·5-candle gas per ton, and 10 cwts. of excellent coke, containing only 5 per cent. of ash.

OLD WEMYSS CANNEL

Yields 13,330 cubic feet of 32·5-candle gas per ton.

Prices and full Analyses on application.

GAS COAL.

POPE & PEARSON, LIMITED, have now the authority of several of the most eminent Gas Engineers of London in stating that their Coal yields *in practical working over* 10,000 *cubic feet of gas, with an illuminating power of* 16 *candles;* or by the standard burners now used by the London Gas Companies, an illuminating power equal to 17½ candles.

One ton yields 12½ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

For further particulars, apply to POPE AND PEARSON, LIMITED, West Riding and Silkstone Collieries, near LEEDS.

SCOTCH CANNEL COALS.

The Subscriber is prepared to contract for the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.

JAMES M'KELVIE,

CANNEL COAL MERCHANT,

HAYMARKET, EDINBURGH.

Established 1840.

WILSON CARTER & PEARSON,

GAS COAL AND CANNEL FACTORS,

Supply to any Railway Station or export Best Wigan Arley Gas Coal and Nuts; best qualities of the Derbyshire, Yorkshire, and North Staffordshire Gas Coals and Nuts; also the best descriptions of Lancashire, Welsh, Scotch, and other Cannel.

Messrs. WILSON CARTER & PEARSON, being contractors to several of the principal Gas Companies in the Midland Counties, have pleasure in being enabled to give them as references.

Chief Offices: Temple Buildings, 50, New Street, Birmingham.

London Offices: 6, Great Winchester St. Buildings, E.C.

GRIRDROD'S PATENT

PORTABLE PIPE SCREWING

MACHINE,

For 1 in., 1¼ in., 1½ in., and 2 in. Gas Threads, complete £7 10s.

In use at the chief gas-works, and giving great satisfaction.

For other useful goods, see Bailey's "Illustrated Inventions," post free 3s. 6d.; gratis to ledger customers.

W. H. BAILEY & CO.,

Brassfounders, Gauge Injector and Tool Makers,

ALBION WORKS, SALFORD,

LANCASHIRE.

ALBERT GAS COAL.

THE DERBYSHIRE

SILKSTONE COAL COMPANY,

LIMITED,

CAN OFFER A

GAS COAL

Of superior quality, delivered in trucks at any Railway Station in England, or shipped on board at Hull, Grimsby Docks, or Barrow-in-Furness.

Purified gas per ton of coal in cubic feet (average)	**10,262**
Illuminating power in candles	**15·86**
Weight of coke in lbs. per ton of coal	**1,502**

ANALYSIS AND PRICES ON APPLICATION TO

Mr. EDMUND TAYLOR, Secretary,

ALBERT COLLIERY, NEWBOLD, NEAR CHESTERFIELD.

THE SILKSTONE & DODWORTH COAL & IRON COMPANY, LIMITED,

DODWORTH, BARNSLEY.

BENJAMIN WHITWORTH, Esq., M.P. . . . . Chairman.
Mr. RICHARD HARTLEY . . . . . Managing Director.

REAL OLD SILKSTONE GAS COAL.

JAMES PATERSON, Esq., Gas Engineer, of the Warrington Gas Company, reported, Aug. 10, 1875:—

"This Coal possesses remarkable qualities as a gas and coking coal, and appears SECOND TO NONE IN THE KINGDOM. It contains the large quantity of 699 lbs. of illuminating matter, and 1498 lbs. of coke to the ton, and produces **12,240** cubic feet of 16·66 candle gas."

The above Company are raising nearly a thousand tons of the Real Old Silkstone Gas Coal per working day.

PRICES QUOTED TO ANY RAILWAY STATION, OR F.O.B. HULL, GRIMSBY, GOOLE, KEADBY, LIVERPOOL, AND FLEETWOOD.

THE

WIGAN & WHISTON COAL COMPANY,

LIMITED,

(COLLIERIES—PRESCOT, NEAR LIVERPOOL)

Are now prepared to supply their

RUSHY PARK GAS COAL,

Either to Gas-Works in England or Wales, or for Shipment, at Runcorn, Garston, Birkenhead, or Liverpool.

This Coal is of superior quality, and yields in practical working over 10,000 cubic feet of Purified Gas per ton, with an Illuminating Power of 17¼ candles.

One Ton of Coal yields 1441 lbs. of good Coke.

For prices, &c., apply either direct to the Colliery or to the Company's Office,

195, FALKNER STREET, LIVERPOOL.

SILKSTONE GAS COAL

AND

LANCASHIRE AND MIDLAND CANNEL.

EMOR G. WRIGLEY, Merchant,

Having made arrangements with four large Collieries for the exclusive sale of their GAS COAL and CANNEL, can offer to Gas Companies large quantities, for delivery over one or two years, at exceedingly low prices. His REAL OLD SILKSTONE GAS COAL will give, in regular work, 10,200 feet 16·6 candle gas and 13 cwt. superior coke; and a WIGAN CANNEL 11,375 feet 21·75 candle gas and 12 cwt. superior coke.

PRICES AND ANALYSIS WILL BE FORWARDED TO ANY PART ON APPLICATION TO THE CHIEF OFFICE,

120a, STAMFORD STREET, ASHTON-UNDER-LYNE.

1862.

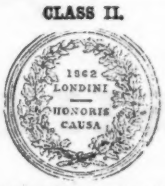
PATENT ANTIMONY PAINT.

MADE ONLY BY

GEORGE HALLETT & CO.,

296, ROTHERHITHE, LONDON, S.E.

CLASS II.



This Paint having been in general use over fifteen years (especially in some of the principal Gas-Works), and proved itself the best light-coloured Paint produced for resisting the influence of vitiated atmospheres, it is important that its qualities should be more widely known.

It is not discoloured like white lead in a sulphuretted atmosphere, nor washed off like white zinc; and its light colour reflecting heat, produces much less expansion of gas in holders painted with it than with dark colours, besides rendering them much more sightly. Its specific gravity is so much below white lead that the same weight will cover one-third more surface, while it is equal in body; and its price being about the same (30s. per cwt.), it is actually one-third cheaper. From experience, its manufacture is greatly improved, and it is quite suitable for all purposes in which white lead is employed.

The following Gas Companies in London have used the Paint for years—viz., The Gaslight and Coke, Imperial, Independent, City of London, Commercial, London, and Surrey Consumers.

N.B.—Antimony Paint, COVERING SO MUCH MORE WORK, costs about 20s. per cwt., as compared with White Lead at 30s. per cwt.; a similar economy arises from its use in Steam and Gas Joints, for which purpose it is superior to White Lead.

SPECIAL DRIERS FOR ANTIMONY PAINT SUPPLIED.

NEWTON, CHAMBERS, & CO.,

THORNCLIFFE IRON-WORKS AND COLLIERIES,

NEAR SHEFFIELD.

CELEBRATED SILKSTONE GAS COALS.

The various descriptions of Gas Coal produced from the above Collieries possess an unequalled reputation, combining in a large degree the constituents essential for the production of the best quality of Coke and Gas of a high illuminating power.

A recent extensive development of the Collieries enables us to offer increased supplies.

JAS. PATERSON, Esq., of Warrington, after testing various qualities of our Coal, has sent the following testimony of their merits:—

Warrington Gaslight and Coke Company,
Offices, Mersey Street, Warrington, April 23, 1877.

Messrs. NEWTON, CHAMBERS, AND CO.,

Gentlemen,

After carefully testing the various samples of Gas Coals sent from your Collieries for analysis, I have pleasure in reporting them as belonging to the highest class of Gas and Coking Coals.

The average of Nine samples gives a yield of 12,500 cubic feet of 15½ Candle Gas, being equivalent to 664 lbs. of sperm per ton, and 1420 lbs. of fixed carbon of a very superior quality. All the samples bear a close relation to each other in value.

Yours truly,

JAMES PATERSON.

Full particulars will be sent on application to us—address as above.

CROLL'S
DRY GAS-METERS,

PRIZE MEDALS. (INVENTED & PATENTED IN 1844,) PRIZE MEDALS.

LONDON, 1851; NEW YORK, 1853 PARIS, 1855.

COMBINING ALL THE LATEST IMPROVEMENTS,

LONDON, 1862; DUBLIN, 1865; PARIS, 1867

MANUFACTURED ONLY BY

THE GAS-METER COMPANY, LIMITED,

238, KINGSLAND ROAD, LONDON, N.E.

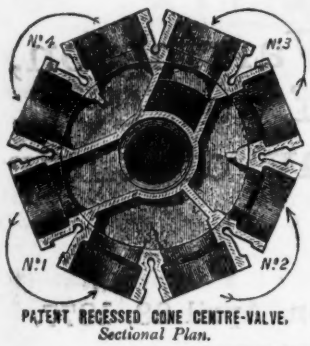
HARRIS & PEARSON,
FIRE-CLAY AND BRICK WORKS, STOURBRIDGE.

GAS-RETORTS, LUMPS, TILES, & FIRE-BRICKS,

OF EVERY DESCRIPTION.

A LARGE ASSORTMENT OF GAS-RETORTS IN STOCK.

STOCK FOR EXPORT READY AT THE WORKS, AND AT ELLESMERE PORT.



PATENT RECESSED CONE CENTRE-VALVE.
Sectional Plan.

R. LAIDLAW AND SON,

EDINBURGH AND GLASGOW,

SOLE MAKERS OF

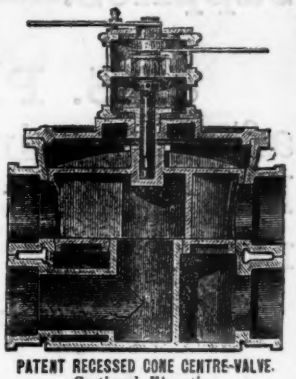
PATENT

RECESSED CONE CENTRE-VALVES,

Constructed on the principle of the ordinary Plug-Cock.

THROUGH-WAY & FOUR-WAY COCKS

Of all descriptions.



PATENT RECESSED CONE CENTRE-VALVE.
Sectional Elevation.

LONDON OFFICE: 106, CANNON STREET.

D. HULETT & CO.

Invite the attention of Gas Companies, Corporations, and others to their

PATENT STREET LAMPS,

Which are so constructed that neither putty nor other materials are required to secure the glass. No hacking out of old putty, which frequently destroys the frames. A new pane of glass can be inserted in two or three minutes by any inexperienced person, the glass being secured by a hinged flap and turn button.

PRICE 10s. each, net. Special quotations for large quantities.
Also made **EXTRA STOUT** recommended for its durability, PRICE 11s. 6d. each.

D. HULETT'S IMPROVED SERVICE CLEANSER,

By the use of which stoppages in service and other pipes are freed from naphthaline and other obstructions in a few minutes. PRICE 73s. net.

HULETT'S PATENT MERCURIAL REGULATOR,

For inserting in mains, to prevent the excess of pressure in high ground, or other elevated positions.

PATENTEES OF IMPROVED WET AND DRY GAS-METERS.

Makers of all kinds of Pressure-Gauges, Gaseliers, and every kind of Gas-Fittings for the Trade.

GAS HEATING AND COOKING STOVES.

55 and 56, HIGH HOLBORN, LONDON.

London: Printed by WILLIAM BOUGHTON KING (at the office of Clayton and Co. 17, Bouverie Street, Fleet Street); and published by him at No. 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, June 5, 1877.